

CAMBRIDGE INTERNATIONAL EXAMINATIONS

**Joint Examination for the School Certificate
and General Certificate of Education Ordinary Level**

MATHEMATICS (SYLLABUS D)

4024/2

PAPER 2

OCTOBER/NOVEMBER SESSION 2002

2 hours 30 minutes

Additional materials:

- Answer paper
- Electronic calculator
- Geometrical instruments
- Graph paper (2 sheets)
- Mathematical tables (optional)

TIME 2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the separate answer paper/answer booklet.

Write your answers and working on the separate answer paper provided.

Show all your working on the same page as the rest of the answer.

Omission of essential working will result in loss of marks.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

You are expected to use an electronic calculator to evaluate explicit numerical expressions. You may use mathematical tables as well if necessary.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

This question paper consists of 9 printed pages and 3 blank pages.



Section A [52 marks]

Answer **all** the questions in this section.

1

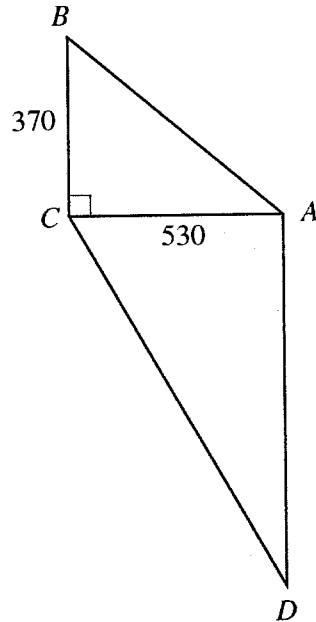


Diagram I

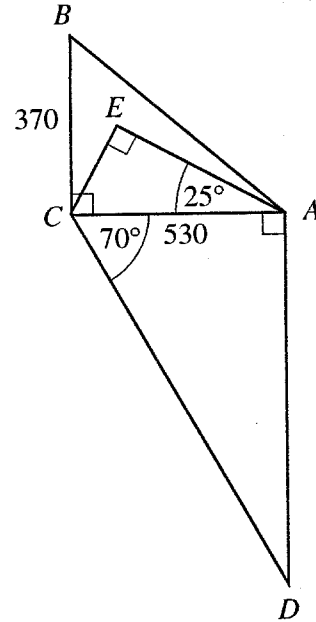


Diagram II

Diagram I shows a path, AC , in a park $ABCD$.It is given that $AC = 530$ m, $BC = 370$ m and that AC is perpendicular to BC .(a) Calculate angle ABC .

[2]

(b) Diagram II shows two other paths, AE and CE , in the park.Given that angle $CAE = 25^\circ$ and angle $AEC = 90^\circ$, calculate the length of AE .

[2]

(c) Given also that angle $ACD = 70^\circ$ and angle $CAD = 90^\circ$, calculate(i) the length of CD ,

[2]

(ii) the area of the park $ABCD$.

[3]

2 (a) Solve the equation $(x - 5)^2 = 81$.

[2]

(b) Express as a single fraction in its simplest form

$$\frac{a}{2a-1} - \frac{2}{a+1}.$$

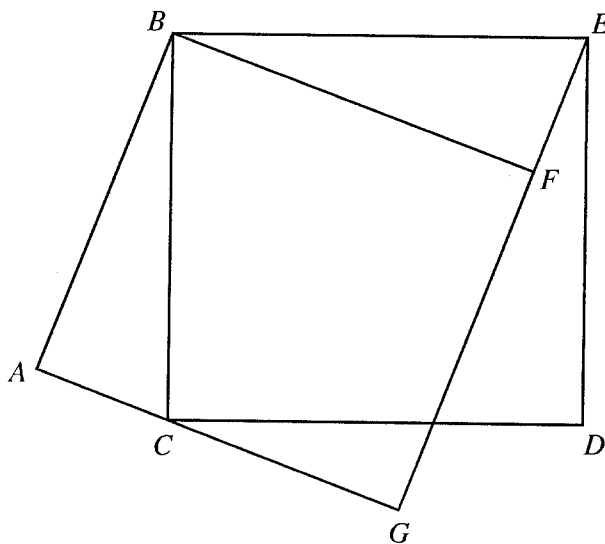
[3]

(c) Given that $A = h(4m + h)$,
express m in terms of h and A .

[3]

- 3 (a) The points A and B are $(-2, 1)$ and $(6, -5)$ respectively.
Calculate
- (i) the gradient of the line AB , [1]
 - (ii) the equation of the line through A and B . [2]
- (b) The points C and D are $(4, 5)$ and (p, q) respectively.
- (i) Write down, in terms of p and q , the coordinates of the midpoint of CD . [1]
 - (ii) Given that the midpoint of CD is $(7, 1)$, find the coordinates of D . [2]
-

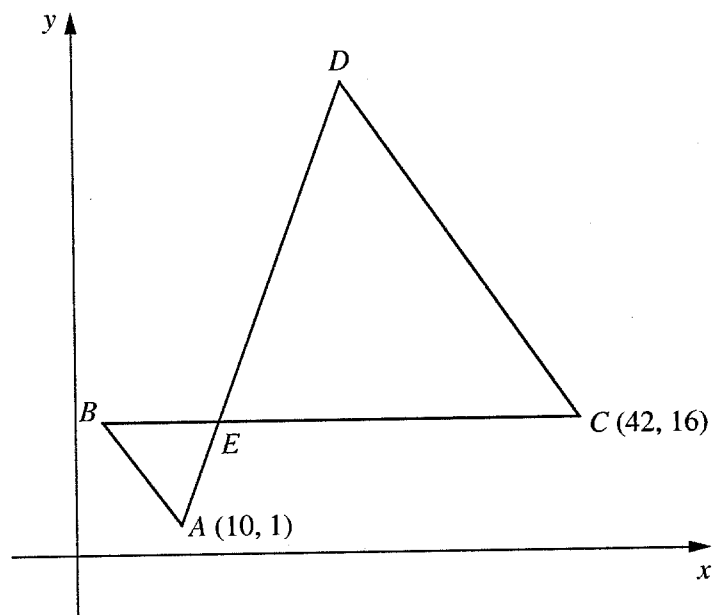
4



In the diagram, $ABFG$ is a rectangle and $BCDE$ is a square.

ACG and GFE are straight lines.

- (a) Show that $\angle ABC = \angle FBE$. [2]
 - (b) Show that triangle ABC is congruent to triangle FBE . [3]
 - (c) **Hence** show that $ABFG$ is a square. [1]
-



In the diagram, A is the point $(10, 1)$ and $\vec{AB} = \begin{pmatrix} -8 \\ 15 \end{pmatrix}$.

(a) Find

(i) $|\vec{AB}|$,

[2]

(ii) the coordinates of B .

[1]

The point C is $(42, 16)$ and $\vec{CD} = 3\vec{AB}$.

(b) Find

(i) the coordinates of D ,

[2]

(ii) the vector $\vec{AD}$.

[1]

The point E is $(k, 16)$.

(c) (i) Find, in terms of k , the vector $\vec{AE}$.

[1]

(ii) Given that AED is a straight line, find k .

[2]

(d) Find $\frac{\text{Area of triangle } ABE}{\text{Area of triangle } CDE}$.

[2]

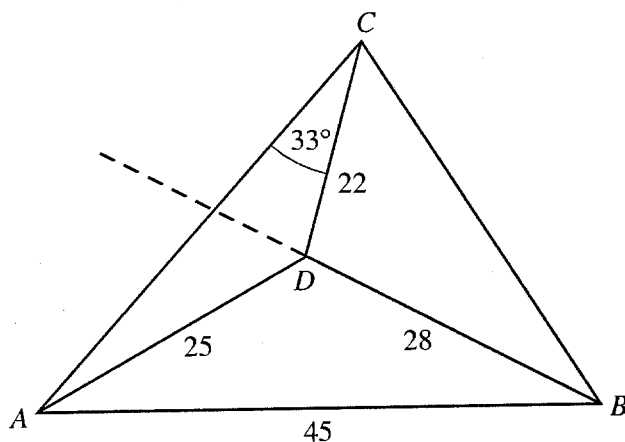
- 6 (a) (i) In 2000 the cost of a packet of nails was \$4.20.
In 2001 the price had increased to \$4.50.
Calculate the percentage increase in the cost of a packet of nails. [2]
- (ii) A new cereal packet contains 20% more than the old packet.
The new packet contains 264 grams of cereal.
Calculate the mass of cereal in one of the old packets. [3]
- (iii) A builder bought a large number of bags of cement.
As a result he was given a discount of 7%.
The discount was \$910.
Calculate how much the builder paid for the cement. [3]
- (b) On 1 May 1998 William invested \$900 for 4 years at 6% per annum simple interest.
(i) Calculate the interest he received on his investment. [2]
(ii) He invested another \$900 for 3 years at 6% per annum simple interest on 1 May 1999,
then \$900 for 2 years at 6% per annum simple interest on 1 May 2000,
and a final \$900 for 1 year at 6% per annum simple interest on 1 May 2001.
William withdrew all of his money on 1 May 2002.
Calculate the total sum that he withdrew. [2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

- 7 A trader bought some paraffin for \$500.
He paid \$ x for each litre of paraffin.
- (a) Find, in terms of x , an expression for the number of litres he bought. [1]
- (b) Due to a leak, he lost 3 litres of paraffin.
He sold the remainder of the paraffin for \$1 per litre more than he paid for it.
Write down an expression, in terms of x , for the sum of money he received. [2]
- (c) He made a profit of \$20.
(i) Write down an equation in x to represent this information, and show that it reduces to
$$3x^2 + 23x - 500 = 0.$$
 [3]
(ii) Solve the equation $3x^2 + 23x - 500 = 0$, giving both answers correct to one decimal place. [4]
- (d) Find, correct to the nearest whole number, how many litres of paraffin he sold. [2]



The diagram shows four points, A , B , C and D , on a piece of horizontal land. It is given that $AB = 45$ metres, $AD = 25$ metres and $BD = 28$ metres.

- (a) Calculate angle ADB . [4]
 - (b) Given also that $CD = 22$ metres and that angle $ACD = 33^\circ$, calculate angle ADC . [3]
 - (c) The line BD is produced beyond D .
Calculate the shortest distance from C to this extended line. [2]
 - (d) D is the foot of a vertical mast, DT .
The angle of elevation of the top of the mast, T , from A is 40° .
Calculate the angle of elevation of T from B . [3]
-

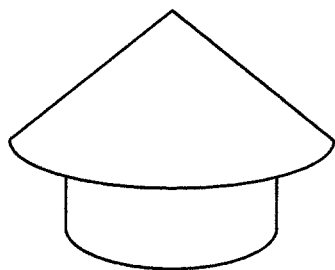
9 [The value of π is 3.142 correct to three decimal places.][The area of the curved surface of a cone of radius r and slant height l is πrl .The volume of a cone is $\frac{1}{3} \times \text{base area} \times \text{height}$.]

Diagram I

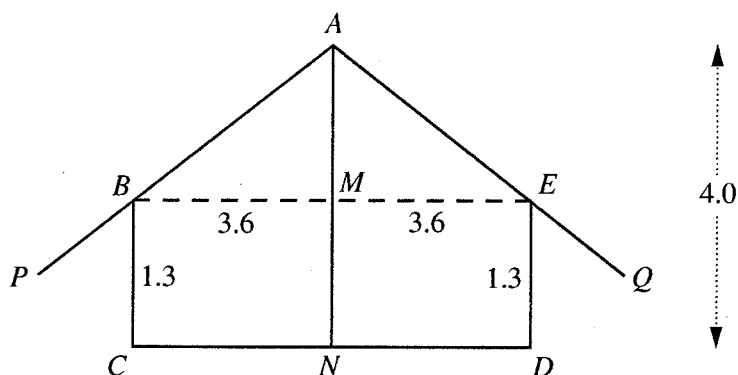


Diagram II

Diagram I shows a traditional hut which consists of a circular cylinder with an overhanging roof. The roof is the curved surface of a cone and is supported by a central vertical pole.

Diagram II shows a vertical cross-section of the hut.

BE and CD are horizontal.

$AN = 4.0$ m, $BM = ME = 3.6$ m and $BC = DE = 1.3$ m.

- (a) Show that $AB = 4.5$ m. [1]
- (b) Calculate
- the volume of the inside of the hut, [3]
 - the **total** surface area of the inside of the hut (including the floor). [4]
- (c) The sun is directly overhead.

The shadow of the overhanging section of the roof on the ground is a circular ring around the hut.

$AP = AQ = 5.5$ m.

Calculate

- PQ , [2]
- the area of the circular ring of shadow **outside** the hut. (Ignore the thickness of the walls.) [2]

10 Answer the whole of this question on a sheet of graph paper.

A man stood at the top of a tower.

He threw a ball vertically upwards.

The height, h metres, of the ball **above the top of the tower** at a time t seconds after it was thrown is given by the formula

$$h = 22t - 4.9t^2.$$

The table below shows some values of t and the corresponding values of h , correct to 1 decimal place.

t	0	1	2	2.5	3	4	5	6
h	0.0	17.1	24.4	24.4	21.9	9.6	-12.5	p

- (a) Explain the significance of the value $h = -12.5$ when $t = 5$. [1]
- (b) Find the value of p . [1]
- (c) Using a scale of 2 cm to 1 second, draw a horizontal t -axis for $0 \leq t \leq 6$.
Using a scale of 2 cm to 10 metres, draw a vertical h -axis for $-50 \leq h \leq 30$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]
- (d) Use your graph to find
- (i) the greatest height of the ball above the top of the tower, [1]
 - (ii) the length of time for which the ball was more than 20 metres above the top of the tower. [2]
- (e) (i) By drawing a tangent, find the gradient of the graph at (4, 9.6). [2]
- (ii) Explain what your answer to (e)(i) tells you about the motion of the ball at $t = 4$. [1]
- (f) The ball hit the ground 5.4 seconds after it was thrown.
Use your graph to find the height of the tower. [1]
-

- 11 (a) A bag contains five balls, numbered 1, 2, 3, 4 and 5.
Another bag contains six balls, numbered 1, 2, 3, 4, 5 and 6.

One ball is drawn at random from each bag.

Find the probability that

- (i) one ball is numbered 1 and the other 6, [1]
- (ii) both balls have an odd number, [1]
- (iii) both balls have the same number, [2]
- (iv) the sum of the numbers on the balls is 9. [2]

- (b) Answer the whole of this part of the question on a sheet of graph paper.

At a school, 300 pupils took an English test.

The table below is the cumulative frequency table for their scores.

Score (s)	≤ 10	≤ 20	≤ 30	≤ 40	≤ 50	≤ 60
Cumulative frequency	15	33	67	142	257	300

- (i) Using a scale of 2 cm to represent 10 marks, draw a horizontal s -axis for $0 \leq s \leq 60$.
Using a scale of 2 cm to represent 50 pupils, draw a vertical axis for values from 0 to 300.
On your axes, draw a smooth cumulative frequency curve to illustrate this information. [2]
 - (ii) Use your graph to find the lower quartile score. [1]
 - (iii) Find the interquartile range of the scores. [1]
 - (iv) Given that 70% of the pupils passed the test, use your graph to find the pass mark. [2]
-

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CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/02

Paper 2

October/November 2003

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
Electronic calculator
Geometrical instruments
Graph paper (3 sheets)
Mathematical tables (optional)

READ THESE INSTRUCTIONS FIRST

Write your answers and working on the separate Answer Booklet/Paper provided.
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, paperclips, highlighters, glue or correction fluid.

SECTION A

Answer **all** questions.

SECTION B

Answer any **four** questions.

At the end of the examination fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.

Show all your working on the same page as the rest of the answer.
Omission of essential working will result in loss of marks.
The total of the marks for this paper is 100.

You are expected to use an electronic calculator to evaluate explicit numerical expressions. You may use mathematical tables as well if necessary.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

This document consists of **10** printed pages and **2** blank pages.



Section A [52 marks]

Answer **all** the questions in this section.

- 1** (a) John opened a bank account.
He deposited \$800 in his account.
The account pays simple interest at the rate of 5% per year.
- Calculate the total amount in his account after 3 years. [2]
- (b) Two telephone companies have different ways of charging their customers.
- (i) Michael uses Company A which charges 6 cents for each unit or part unit of time.
A unit of time is 200 seconds.
He makes a call lasting 1 hour 22 minutes.
- Calculate the cost of his call. [2]
- (ii) Norman uses Company B which charges 5 cents for each of the first 400 units.
The charge for each additional unit is reduced by one quarter.
There is also a fixed charge of \$27 for the use of the equipment.
- He is charged for 629 units.
- Calculate, correct to the nearest cent, the total sum that he has to pay. [3]
-

- 2** A company manufactures biscuits.
- (a) One batch of biscuits contains 300 grams of dried fruit.
This consists of sultanas and currants, with masses in the ratio 2 : 3.
- Find the mass of the sultanas. [2]
- (b) The mixture used to make one batch of biscuits has a mass of 18 kg.
The mixture loses 12% of its mass when it is cooked to make the biscuits.
- (i) Calculate the mass of one batch of biscuits. [2]
- (ii) Each biscuit has a mass of 12 grams.
One batch of biscuits is put into packets.
Each packet contains 16 biscuits.
- Find how many packets can be filled, and the number of biscuits remaining. [2]
- (iii) The total mass of each packet, including packaging, is 201 grams.
- Express the mass of the packaging as a percentage of the total mass of a packet. [2]
- (c) A trader sells one packet of biscuits for 80 cents.
He makes a profit of 25% of his cost price.
- Calculate the price he paid for a packet of biscuits. [2]
-

- 3 (a) Solve the equation $(2x - 3)(x - 4) = 18$. [3]
- (b) A formula used in connection with a mirror is $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$.
- (i) Given that $v = 9$ and $f = 5$, find u . [1]
- (ii) Express v in terms of u and f . [2]
- (c) A man bought a eggs at r cents per dozen.
He sold them for s cents each.
- Find an expression, in terms of a , r and s , for the profit, in cents, that he made. [2]
-

4 Answer the whole of this question on a sheet of graph paper.

The speeds of 50 cars being driven along a stretch of road were recorded.
The table below shows the distribution of the speeds of the cars.

Speed (v km/h)	$20 < v \leq 40$	$40 < v \leq 50$	$50 < v \leq 55$	$55 < v \leq 60$	$60 < v \leq 70$	$70 < v \leq 110$
Frequency	4	14	10	8	10	4

- (a) Using a scale of 1 cm to represent 10 km/h, draw a horizontal axis for speeds up to 110 km/h.
Using a scale of 4 cm to represent 1 unit, draw a vertical axis for frequency densities from 0 to 2 units.
- On your axes, draw a histogram to represent the information in the table. [3]
- (b) Write down the modal class of the distribution. [1]
- (c) In which interval is the upper quartile of the distribution? [1]
- (d) Find the probability that one car, selected at random, had a speed of
- (i) less than 20 km/h, [1]
- (ii) more than 60 km/h. [1]
- (e) There is a speed limit of 60 km/h on this stretch of road.
Two cars were selected at random.
- Calculate the probability that one car was breaking the speed limit and the other was not breaking the limit. [2]
-

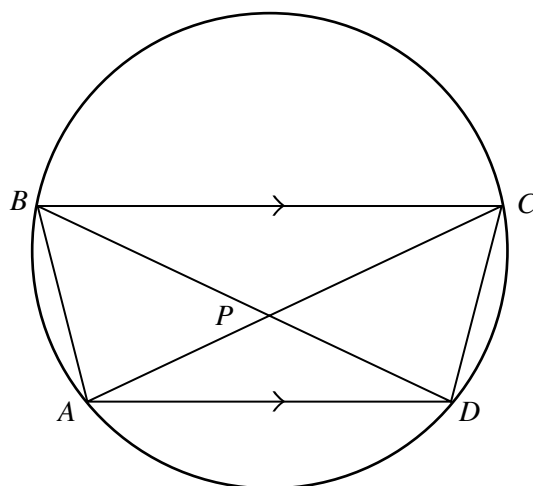


Diagram I

The points A , B , C and D lie on a circle as shown on Diagram I.
 AC cuts BD at P .
 AD is parallel to BC .

(a) Show that triangle BPC is an isosceles triangle. [2]

(b) Given that angle $ACB = 32^\circ$ and angle $DAB = 118^\circ$,
 calculate angle ACD . [2]

(c)

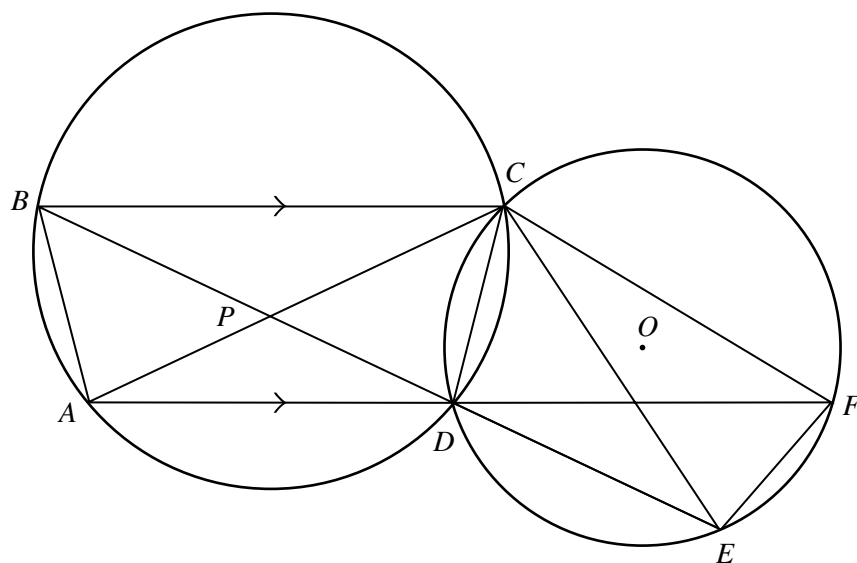


Diagram II

Diagram II shows the circle in Diagram I and a second circle, centre O .
 The two circles intersect at C and D .
 AD produced cuts the second circle at F .
 BD produced cuts the second circle at E .
 Angle $DEF = 110^\circ$.

Calculate

(i) angle ACE , [3]

(ii) angle COD . [2]

6

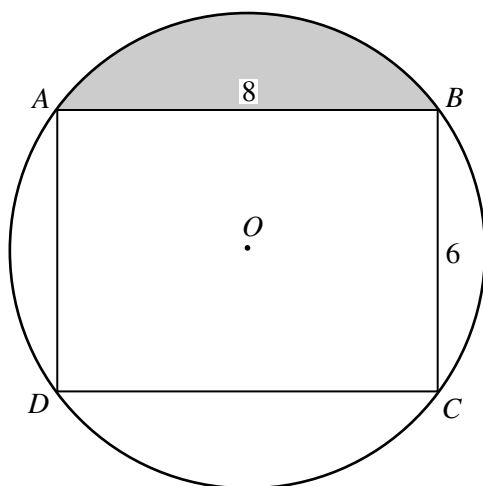


Diagram I

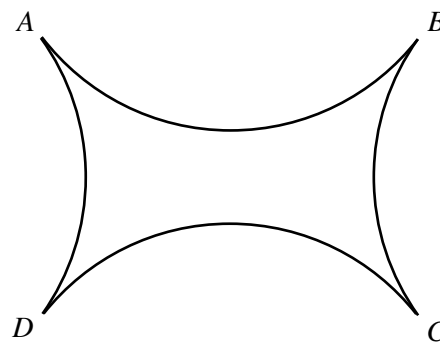


Diagram II

$ABCD$ is a rectangle in which $AB = 8$ cm and $BC = 6$ cm.

A circular piece of wire, centre O , passes through the vertices of the rectangle as shown in Diagram I.

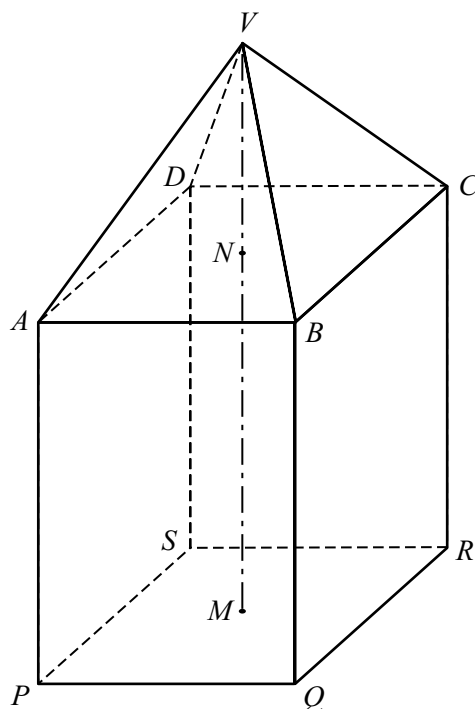
- (a) Show that the radius of the circular wire is 5 cm. [1]
- (b) Show that angle $AOB = 106.3^\circ$, correct to 1 decimal place. [2]
- (c) Calculate the area of the shaded segment. [3]
- (d) The circular wire is cut at A , B , C and D , and the four pieces joined to form the shape shown in Diagram II.

Calculate the area enclosed by the wires in Diagram II. [3]

Section B [48 marks]

Answer **four** questions in this section.
Each question in this section carries 12 marks.

- 7 [The volume of a pyramid = $\frac{1}{3} \times \text{base area} \times \text{height}$.]



The diagram shows a solid traffic bollard.

It consists of a square-based pyramid, $VABCD$, attached to a cuboid, $ABCDPQRS$.

The vertical line, VNM , passes through the centres, N and M , of the horizontal squares $ABCD$ and $PQRS$.

$AB = BC = 60$ cm and $VN = 40$ cm.

(a) Calculate

- (i) VA , [2]
- (ii) angle VAN , [2]
- (iii) angle VAP . [1]

(b) Given also that $AP = BQ = CR = DS = 80$ cm, calculate

- (i) the volume of the bollard, [2]
- (ii) the total surface area of the sides and top of the bollard. [3]

(c) The highway authority needs to paint the sides and tops of 17 of these bollards.
The paint is supplied in tins, each of which contains enough paint to cover 8 m^2 .

Find the number of tins of paint needed. [2]

- 8** A polar explorer is planning an expedition.
He investigates three possible routes.

- (a) If he travels on route A, which is 800 km long, he expects to cover x km per day.

Route B, which is the same distance as route A, has more difficult ice conditions and he would only expect to cover $(x - 5)$ km per day.

Route C, which is 100 km longer than route A, has easier conditions and he would expect to cover $(x + 5)$ km per day.

Write down an expression, in terms of x , for the number of days that he expects to take on

(i) route A,

(ii) route B,

(iii) route C. [2]

- (b) He estimates that route C will take 20 days less than route B.

Form an equation in x , and show that it reduces to $x^2 + 5x - 450 = 0$. [4]

- (c) Solve the equation $x^2 + 5x - 450 = 0$, giving both answers correct to 1 decimal place. [4]

- (d) Calculate the number of days that he expects to take on route A. [2]
-

9 Answer the whole of this question on a sheet of graph paper.

An **open** rectangular tank has a square base of side x metres.
The volume of the tank is 36 m^3 .

- (a) (i) Find an expression, in terms of x , for the height of the tank. [1]
(ii) Hence show that the total external surface area of the tank, A square metres, is given by

$$A = x^2 + \frac{144}{x}. \quad [1]$$

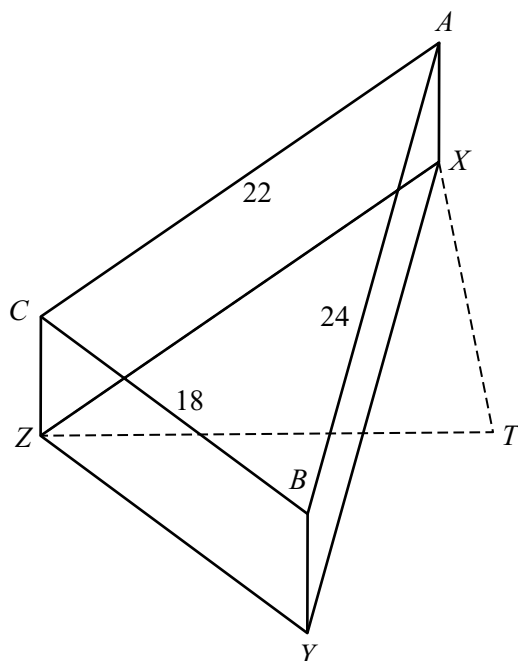
- (b) The table below shows some values of x and the corresponding values of A , correct to 1 decimal place, where $A = x^2 + \frac{144}{x}$.

x	2	2.5	3	4	5	6	7	8
A	76.0	63.9	57.0	52.0	53.8	60.0	69.6	p

- (i) Find the value of p . [1]
(ii) Using a scale of 2 cm to 1 metre, draw a horizontal x -axis for $2 \leq x \leq 8$.
Using a scale of 2 cm to 10 m^2 , draw a vertical A -axis for $40 \leq A \leq 90$.

On your axes, plot the points given in the table and join them with a smooth curve. [3]

- (iii) Use your graph to find
(a) the values of x for which the surface area is 65 m^2 , [2]
(b) the gradient of the curve at $x = 6$, [2]
(c) the dimensions of the tank which has the least possible surface area. [2]
-



An aircraft waiting to land is flying around a triangular circuit ABC .

A , B and C are vertically above three beacons, X , Y and Z .

T is the control tower at the airport, and T , X , Y and Z lie in a horizontal plane.

$BC = 18$ km, $CA = 22$ km and $AB = 24$ km.

(a) (i) The plane is flying at 200 km/h.

Calculate the time, in minutes and seconds, that the aircraft takes to complete one circuit.

[2]

(ii) Calculate the largest angle of triangle ABC .

[4]

(b) Z is due West of T .

The bearing of X from Z is 042° and the bearing of X from T is 338° .

(i) Find the angles of triangle TXZ .

[2]

(ii) Calculate TX .

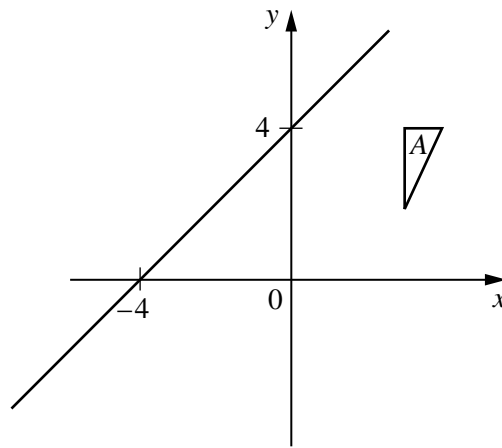
[2]

(c) The aircraft is flying at a constant height of 2600 metres.

Calculate the angle of depression of the tower, T , from the aircraft when it is at A .

[2]

11 Answer the whole of this question on a sheet of graph paper.



The diagram shows triangle A and the straight line $y = x + 4$.
Triangle A has vertices $(3, 2)$, $(3, 4)$ and $(4, 4)$.

- (a) Using a scale of 1 cm to represent 1 unit on each axis, draw, on a sheet of graph paper, axes for values of x and y in the ranges $-6 \leq x \leq 6$ and $-6 \leq y \leq 10$.

Draw and label triangle A .

Draw the straight line $y = x + 4$.

[1]

- (b) The transformation M is a reflection in the line $y = x + 4$.
The transformation M maps triangle A onto triangle B , so that $M(A) = B$.

Draw and label triangle B .

[2]

- (c) Triangle C has vertices $(-1, 2)$, $(1, 2)$ and $(1, 1)$.
The rotation R maps triangle A onto triangle C , so that $R(A) = C$.

Find

- (i) the angle and direction of this rotation,
(ii) the coordinates of the centre of this rotation.

[2]

- (d) Given that $MR(A) = D$, draw and label triangle D .

[2]

- (e) The matrix $\begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix}$ represents the transformation N which maps triangle A onto triangle E .

- (i) Find the coordinates of the vertices of triangle E .

[2]

- (ii) Describe fully the transformation N .

[2]

- (iii) Write down the matrix that represents the transformation which maps triangle E onto triangle A .

[1]

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/02

Paper 2

October/November 2004

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
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Geometrical instruments
Graph paper (2 sheets)
Mathematical tables (optional)

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For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

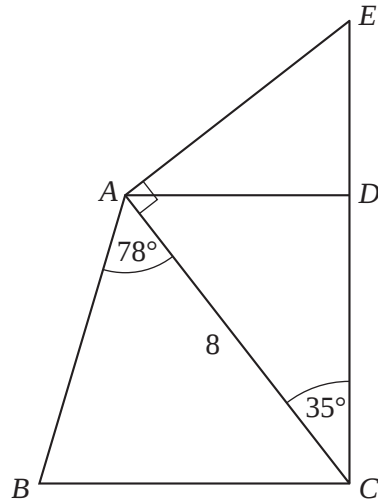
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Section A [52 marks]

Answer **all** the questions in this section.

1



The diagram represents some beams which support part of a roof.

AD and BC are horizontal and CDE is vertical.

$AC = 8$ metres, $\hat{BAC} = 78^\circ$, $\hat{ACD} = 35^\circ$ and $\hat{CAE} = 90^\circ$.

Calculate the length of the beam

- | | |
|------------|-----|
| (a) AD , | [2] |
| (b) CE , | [2] |
| (c) AB . | [3] |
-

2 The points A , B and C are $(9, 8)$, $(12, 4)$ and $(4, -2)$ respectively.

(a) Find

(i) the gradient of the line through A and B , [1]

(ii) the equation of the line through C which is parallel to AB . [2]

(b) Calculate the length of the line segment

(i) AB , [1]

(ii) BC . [1]

(c) Show that AB is perpendicular to BC . [1]

(d) Calculate the area of triangle ABC . [1]

3 Mr Smith bought three companies, Alpha, Beta and Gamma, for a total of \$80 000 000.

The amounts he paid for these companies were in the ratio 4 : 5 : 7.

(a) Calculate how much he paid for each company. [2]

(b) When he sold the companies, he made a profit of 12% on the \$80 000 000 he paid for them.

Calculate the profit he made on the sale of the three companies. [1]

(c) When he sold the companies, he made a profit of 25% on Alpha and a loss of 10% on Beta.

Calculate

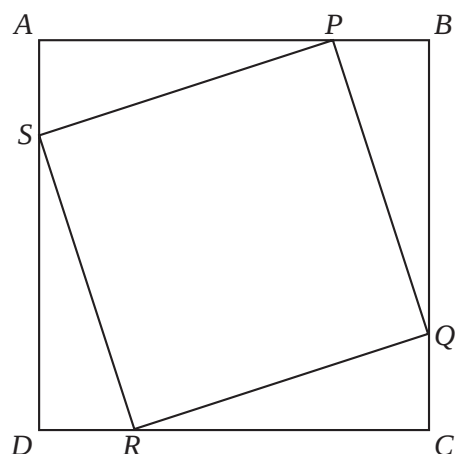
(i) the profit he made on Alpha, [1]

(ii) the percentage profit that he made on Gamma. [3]

(d) When the previous owner, Mr Jones, sold the companies to Mr Smith for \$80 000 000, he made a profit of 60%.

Calculate the total amount Mr Jones had paid for the companies. [2]

4



In the diagram, $ABCD$ is a square.

Points P , Q , R and S lie on AB , BC , CD and DA so that $AP = BQ = CR = DS$.

(a) Giving all your reasons, show that

(i) $PB = QC$, [2]

(ii) triangle BPQ is congruent to triangle CQR , [3]

(iii) PQR is a right angle. [2]

(b) Write down two reasons to show that $PQRS$ is a square. [2]

5 (a) It is given that $S = \frac{n(a+l)}{2}$.

(i) Find the value of S when $n = 20$, $a = -5$ and $l = 17$. [1]

(ii) Express l in terms of S , n and a . [2]

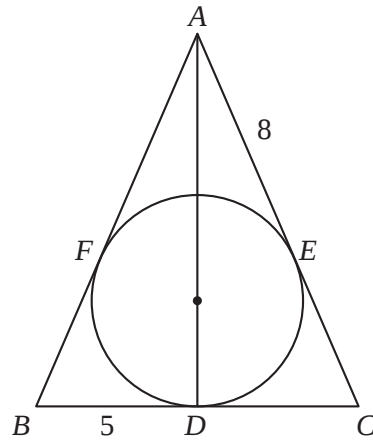
(b) Solve the equations

(i) $5t^2 = 12t$, [2]

(ii) $\frac{y-1}{8} = \frac{2}{y-1}$. [3]

(c) Solve the equation $3x^2 + 9x + 5 = 0$, giving both answers correct to two decimal places. [4]

6 (a)



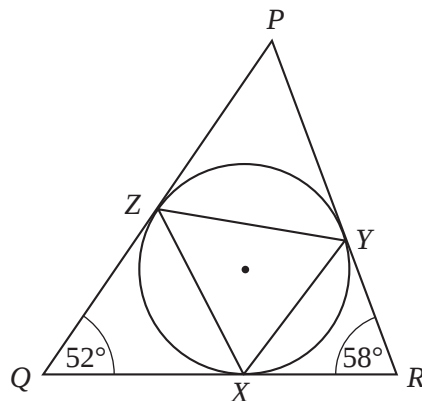
The diagram shows a circle which passes through D , E and F .
 AFB , BDC and CEA are tangents to the circle.
 D is the midpoint of BC .

Given that $BD = 5$ cm and $AE = 8$ cm, find

(i) EC , [1]

(ii) $\hat{CAD}$. [2]

(b)



The diagram shows a circle which passes through X , Y and Z .
 PZQ , QXR and RYP are tangents to the circle.

Given that $\hat{PQR} = 52^\circ$ and $\hat{PRQ} = 58^\circ$, calculate

(i) $\hat{QPR}$, [1]

(ii) $\hat{QZX}$, [2]

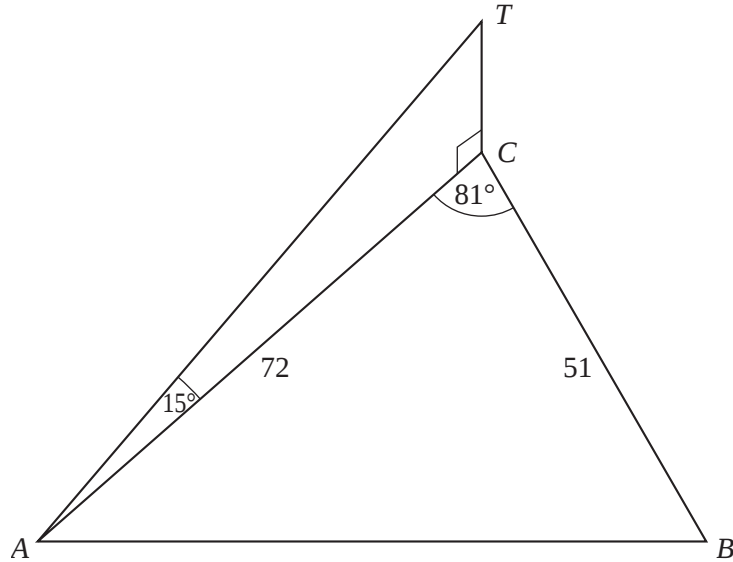
(iii) $\hat{ZXY}$. [2]

Section B [48 marks]

Answer **four** questions in this section.

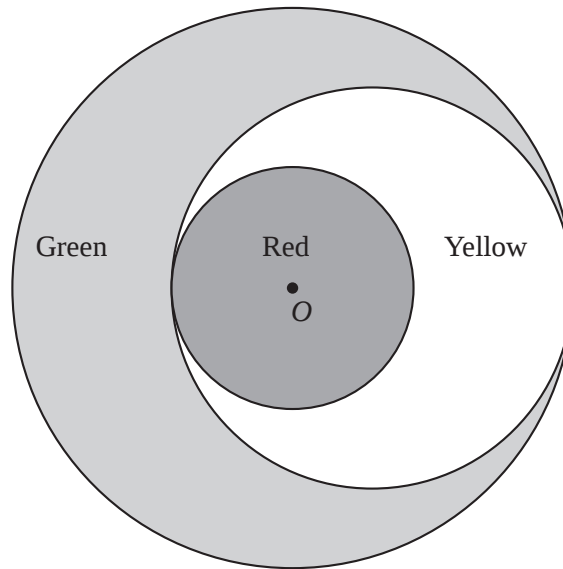
Each question in this section carries 12 marks.

7



Three paths, AB , BC and CA , run along the edges of a horizontal triangular field ABC .
 $BC = 51$ m, $AC = 72$ m and angle $ACB = 81^\circ$.

- (a) Calculate the length of AB . [4]
- (b) Calculate the area of the field ABC . [2]
- (c) Calculate the shortest distance from C to AB . [2]
- (d) A vertical tree, CT , has its base at C .
 The angle of elevation of the top of the tree from A is 15° .
 Calculate the height of the tree. [2]
- (e) John measured the largest angle of elevation of the top of the tree as seen from the path AB .
 Calculate this angle of elevation. [2]



The diagram shows the design of a company symbol.

It consists of three circles.

The smallest circle has centre O and radius $2x$ centimetres.

The largest circle has centre O and radius $2y$ centimetres.

The third circle touches both the other two circles as shown.

The three regions formed are coloured red, yellow and green as shown.

- (a) Explain fully why the radius of the third circle is $(x + y)$ centimetres. [2]
- (b) Write down, in terms of π , x and y , expressions for the area of the region that is coloured
- (i) yellow, [1]
- (ii) green. [1]
- (c) The area of the green region is twice the area of the yellow region.
Use this information to write down an equation involving x and y , and show that it simplifies to
- $$y^2 - 6xy + 5x^2 = 0. \quad [3]$$
- (d) (i) Factorise $y^2 - 6xy + 5x^2$. [1]
- (ii) Solve the equation $y^2 - 6xy + 5x^2 = 0$, expressing y in terms of x . [2]
- (e) Calculate the fraction of the design that is coloured yellow. [2]

- 9 Three integers, a , b and c , are such that $a < b < c$.

The three integers are said to form a Pythagorean Triple if $c^2 = a^2 + b^2$ or $c^2 - b^2 = a^2$.

For example

3, 4, 5 form a Pythagorean Triple because $5^2 - 4^2 = (5 - 4)(5 + 4) = 1 \times 9 = 9 = 3^2$
and 5, 12, 13 form a Pythagorean Triple because $13^2 - 12^2 = (13 - 12)(13 + 12) = 1 \times 25 = 25 = 5^2$.

- (a) In the same way, show that 7, 24 and 25 form a Pythagorean Triple. [1]

- (b) Form a Pythagorean Triple

- (i) in which the last two integers are 40 and 41, [1]

- (ii) in which the first integer is 11. [1]

- (c) (i) Simplify $(n + 1)^2 - n^2$. [1]

- (ii) Hence form a Pythagorean Triple in which the first integer is 101. [2]

- (d) It is also possible to form Pythagorean Triples in which the last two integers differ by 2.

For example

8, 15, 17 form a Pythagorean Triple because $17^2 - 15^2 = (17 - 15)(17 + 15) = 2 \times 32 = 64 = 8^2$.

- (i) Copy and complete the following statements:

..., 35, 37 form a Pythagorean Triple because $37^2 - 35^2 = (\quad)(\quad) = \dots \times \dots = \dots = \dots$. [1]

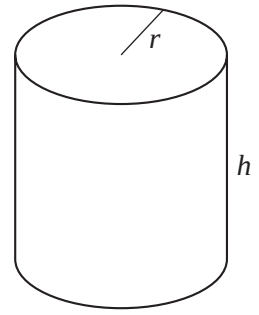
16, ..., ... form a Pythagorean Triple because $\dots - \dots = (\quad)(\quad) = 2 \times \dots = \dots = 16^2$. [2]

- (ii) Simplify $(4n^2 + 1)^2 - (4n^2 - 1)^2$ and hence express it as a perfect square. [2]

- (iii) Form a Pythagorean Triple in which the first integer is 400 and the other two integers differ by 2. [1]

10 Answer the whole of this question on a sheet of graph paper.

A solid cylinder of radius r centimetres and height h centimetres has a volume of $100\pi \text{ cm}^3$.



(a) (i) Show that $h = \frac{100}{r^2}$. [1]

(ii) The cylinder has a total surface area of πy square centimetres.

Show that $y = 2r^2 + \frac{200}{r}$. [1]

(b) The table below shows some values of r and the corresponding values of y , correct to the nearest whole number.

r	1	1.5	2	3	4	5	6
y	202	138	108	85	82	90	p

(i) Find the value of p . [1]

(ii) Using a scale of 2 cm to represent 1 cm, draw a horizontal r -axis for $1 \leq r \leq 6$.
Using a scale of 2 cm to represent 20 cm^2 , draw a vertical y -axis for $70 \leq y \leq 220$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]

(c) Use your graph to find the values of r for which $y = 100$. [2]

(d) By drawing a tangent, find the gradient of the graph at the point where $r = 2$. [2]

(e) Use your graph to find

(i) the value of r for which y is least, [1]

(ii) the smallest possible value of the total surface area of the cylinder. [1]

11 Answer the whole of this question on a sheet of graph paper.

The table below shows the marks obtained in tests of English and Mathematics by 140 students.

Mark (x)	Number of candidates	
	English	Mathematics
$0 < x \leq 20$	4	10
$20 < x \leq 40$	26	20
$40 < x \leq 60$	50	30
$60 < x \leq 80$	56	55
$80 < x \leq 100$	4	25

(a) Copy and complete the cumulative frequency table below.

Mark (x)	Number of candidates	
	English	Mathematics
$x = 0$	0	0
$x \leq 20$	4	
$x \leq 40$		
$x \leq 60$		
$x \leq 80$		
$x \leq 100$	140	

[2]

(b) Using a scale of 2 cm to represent 20 marks, draw a horizontal x -axis for $0 \leq x \leq 100$. Using a scale of 2 cm to represent 20 pupils, draw a vertical axis for values from 0 to 140. On your axes, draw and label both smooth cumulative frequency curves to illustrate this information.

[3]

(c) Use your curves to find

(i) the upper quartile mark for English,

[1]

(ii) the interquartile range for English,

[1]

(iii) the median mark for English and the median mark for Mathematics.

[1]

(d) State, with a reason, which you think is the easier test.

[1]

(e) One student is chosen at random.

It may be assumed that the marks gained in the two subjects are independent.

Expressing each answer as a fraction in its lowest terms, calculate the probability that the student gains

(i) more than 60 marks on both papers,

[1]

(ii) more than 80 marks on one paper, but not on the other.

[2]

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/02

Paper 2

October/November 2005

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
Electronic calculator
Geometrical instruments
Graph paper (2 sheets)
Mathematical tables (optional)

READ THESE INSTRUCTIONS FIRST

Write your answers and working on the separate Answer Booklet/Paper provided.
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.

Show all your working on the same page as the rest of the answer.
Omission of essential working will result in loss of marks.
The total of the marks for this paper is 100.
You are expected to use an electronic calculator to evaluate explicit numerical expressions. You may use mathematical tables as well if necessary.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

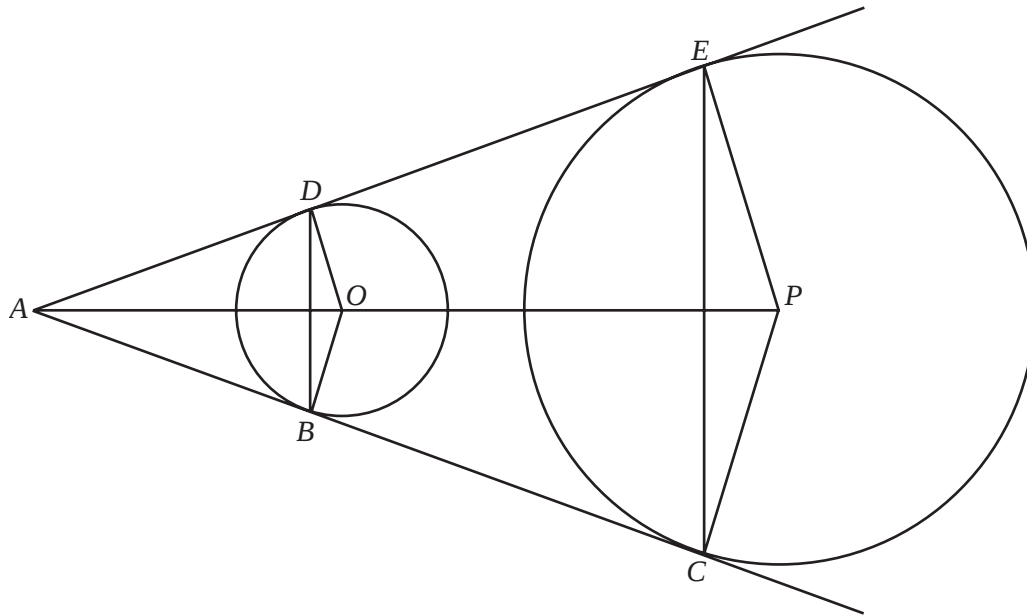
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Section A [52 marks]

Answer **all** the questions in this section.

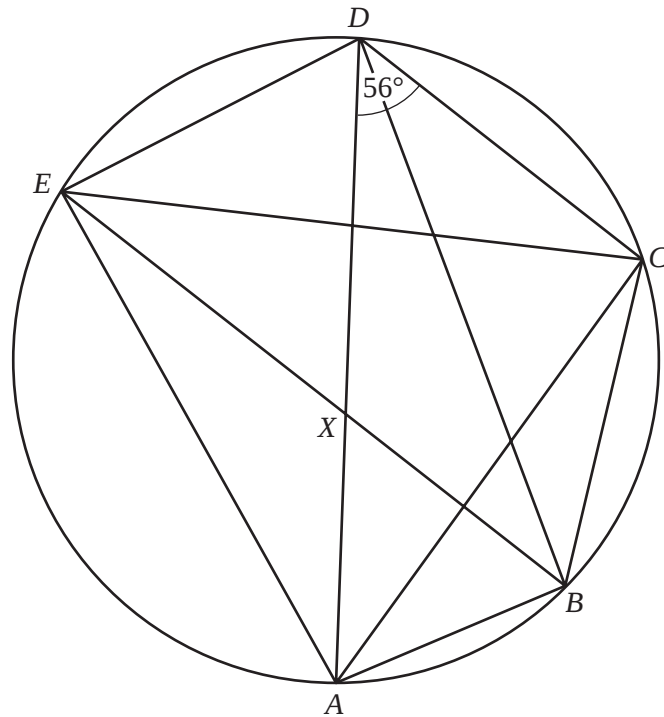
1



The diagram shows two circles with centres O and P .
 ABC and ADE are tangents to the circles at B , C , D and E as shown.
 AOP is a straight line.

- (a) Giving a reason for your answer, write down angle ABO . [1]
- (b) It is given that $OB = 6$ cm, $AO = 13$ cm and $PC = 15$ cm.
- (i) Show that angle $OAB = 27.5^\circ$, correct to one decimal place. [1]
- (ii) Calculate AC . [2]
- (iii) Calculate CE . [3]

- 2 (a) Solve the equation $\frac{3t+1}{2} = 4$. [2]
- (b) Solve the simultaneous equations
- $$\begin{aligned} 2x + y &= 12, \\ 3y - 2x &= 56. \end{aligned}$$
- [2]
- (c) Simplify $\frac{3y^2 + 8y + 4}{y^2 - 4}$. [3]
- (d) Given that $3h + 2x = 2f - gx$, express x in terms of f , g and h . [3]



The points A , B , C , D and E lie on a circle.
 AD is a diameter of the circle.
 DB bisects angle ADC .
 Angle $ADC = 56^\circ$.

(a) Giving your reasons, write down

(i) angle DCA , [1]

(ii) angle DAC , [1]

(iii) angle CBA , [1]

(iv) angle AEB . [1]

(b) It is given that EB is parallel to DC and that EB cuts AD at X .
 [You **must not** assume that X is the centre of the circle.]

Show that triangle BDX is isosceles. [2]

(c) Find angle EBA . [1]

(d) Hence or otherwise show that X is the centre of the circle. [1]

4 Answer the whole of this question on a sheet of graph paper.

The table shows the number of cars owned by each of 25 families.

2	0	3	4	1
0	1	1	2	3
2	3	6	1	0
1	2	0	3	2
3	4	1	2	1

- (a) Draw a bar chart to represent the information in the table. [2]
- (b) Find
- (i) the median number of cars, [1]
 - (ii) the modal number of cars, [1]
 - (iii) the mean number of cars. [1]
- (c) A **family** is chosen at random.
Find the probability that it owns 3 cars. [1]
- (d) Two **families** are chosen at random.
Find the probability that one family owns 2 cars and the other owns 4 cars. [2]
- (e) A **car** is chosen at random.
Find the probability that it belongs to a family which owns 2 cars. [2]
-

- 5 The cost of parking in a car park is 10 cents for each hour.
When he parked his car, John had only a large number of 10 cents coins and 20 cent coins to put into the ticket machine.
The table shows how he can pay to park his car.

Parking time (hours)	Ways of paying (amounts in cents)	Number of ways of paying to park
1	10	1
2	10 then 10 20	2
3	10 then 10 then 10 10 then 20 20 then 10	3

- (a) Show that there are
- (i) 5 ways to pay for 4 hours, [1]
- (ii) 8 ways to pay for 5 hours. [1]
- (b) The table below shows the number of ways John can pay when parking for various times.

Time (hours)	1	2	3	4	5	6	7		n	$n + 1$	$n + 2$
Number of ways	1	2	3	5	8	a	b		x	y	z

- (i) Find the values of a and b . [3]
- (ii) Write down an equation connecting x , y and z . [1]

- 6 A road tanker holds 24 tonnes of oil.

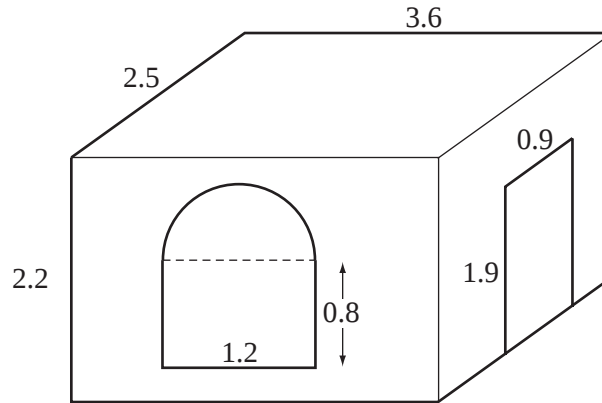
- (a) In cold weather it can pump out x tonnes of oil per minute.
Write down an expression, in terms of x , for the number of minutes it takes to empty the tanker in cold weather. [1]
- (b) In hot weather it can pump out $(x + 0.5)$ tonnes of oil per minute.
Write down an expression, in terms of x , for the number of minutes it takes to empty the tanker in hot weather. [1]
- (c) It takes 2 minutes longer to empty the tanker in cold weather than in hot weather.
Write down an equation in x , and show that it simplifies to
- $$2x^2 + x - 12 = 0. \quad [3]$$
- (d) Solve the equation $2x^2 + x - 12 = 0$, giving the solutions **correct to 3 decimal places**. [4]
- (e) Find the time taken, in minutes and seconds, correct to the nearest second, to empty the tanker in cold weather. [2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

7

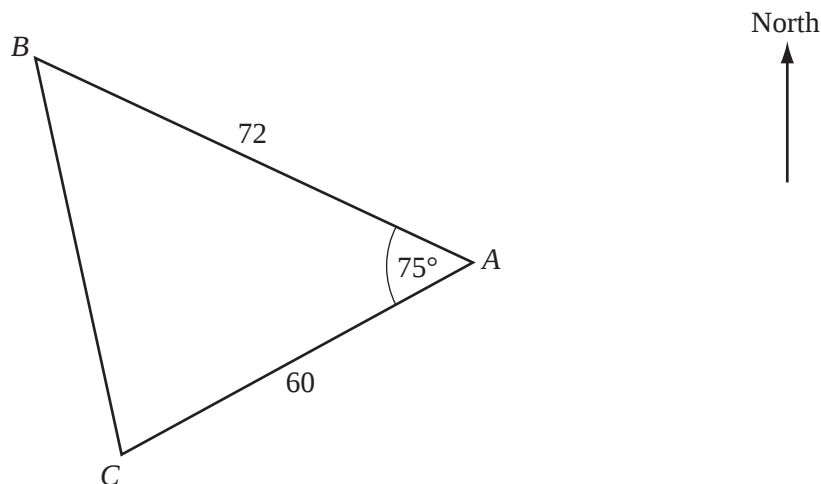


A room has length 3.6 m, width 2.5 m and height 2.2 m.

It has one door which is a rectangle of width 0.9 m and height 1.9 m.

It has one window which is a rectangle of width 1.2 m and height 0.8 m, with a semicircle on one of its longer sides.

- (a) (i) Calculate the area of the window. [2]
- (ii) Show that the area of the walls, correct to three significant figures, is 23.6 m^2 . [2]
- (b) Tiles are to be fixed to the walls inside the room.
 Eileen estimated the number of tiles needed to cover the walls inside the room in the following way.
 She first increased the area, 23.6 m^2 , by 12% and then calculated the number of tiles that she needed to cover this total area.
 Each tile is a square of side 25 cm.
- (i) Find the number of tiles that she needed. [3]
- (ii) The tiles are sold in boxes, each containing 20 tiles.
 Each box of tiles costs \$15.
 Calculate the cost of the boxes of tiles that she bought. [2]
- (iii) When the shopkeeper sold the tiles at \$15 per box, he made a profit of 20%.
 Calculate the profit that he made on each box. [3]



Three points, A , B and C , lie on a horizontal field.
 Angle $BAC = 75^\circ$ and the bearing of C from A is 217° .
 $AB = 72$ m and $AC = 60$ m.

(a) Calculate

- (i) the bearing of B from A , [1]
- (ii) BC , [4]
- (iii) angle ABC , [3]
- (iv) the bearing of C from B . [1]

(b) A girl standing at B is flying a kite.

The kite, K , is vertically above A .

The string, BK , attached to the kite is at 24° to the horizontal.

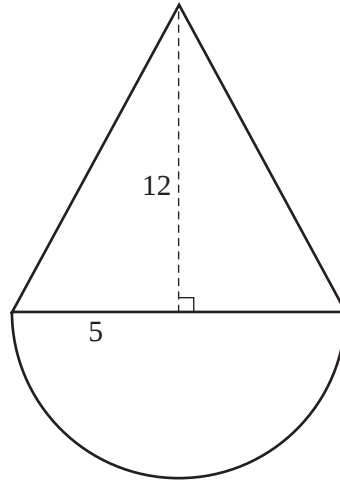
Calculate the angle of elevation of the kite when viewed from C . [3]

9 [The surface area of a sphere = $4\pi r^2$.]

[The volume of a sphere = $\frac{4}{3}\pi r^3$.]

[The area of the curved surface of a cone of radius r and slant height l is $\pi r l$.]

[The volume of a cone = $\frac{1}{3} \times \text{base area} \times \text{height}$.]



A solid cone has a base radius of 5 cm and height 12 cm.

A solid hemisphere has a radius of 5 cm.

A metal toy is formed by joining the plane faces of the cone and the hemisphere.

(a) Show that the length of the slant edge of the cone is 13 cm. [1]

(b) Calculate

(i) the surface area of the toy, [4]

(ii) the volume of the toy. [3]

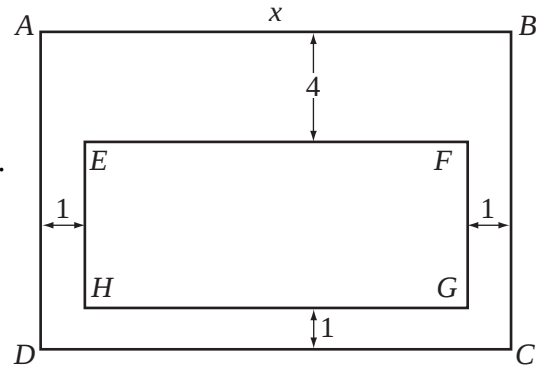
(c) A solid metal cylinder has a radius of 1.5 m and height 2 m.

The cylinder was melted down and all of the metal was used to make a large number of these toys.

Calculate the number of toys that were made. [4]

10 Answer the whole of this question on a sheet of graph paper.

The area of a rectangular garden, $ABCD$, is 100 m^2 .
 Inside the garden there is a rectangular lawn, $EFGH$,
 whose sides are parallel to those of the garden.
 EF is 4 m from AB .
 FG , GH and HE are 1 m from BC , CD and DA respectively.



(a) Taking the length of AB to be x metres, write down expressions, in terms of x , for

- (i) EF ,
- (ii) BC ,
- (iii) FG .

[2]

(b) Hence show that the area, y square metres, of the lawn, $EFGH$ is given by

$$y = 110 - 5x - \frac{200}{x}. \quad [1]$$

(c) The table below shows some values of x and the corresponding values of y , correct to 1 decimal place, where

$$y = 110 - 5x - \frac{200}{x}.$$

x	4	5	6	7	8	9	10
y	p	45.0	46.7	46.4	45.0	42.8	40.0

Find the value of p .

[1]

(d) Using a scale of 2 cm to 1 metre, draw a horizontal x -axis for $4 \leq x \leq 10$.

Using a scale of 2 cm to 2 square metres, draw a vertical y -axis for $40 \leq y \leq 48$.

On your axes, plot the points given in the table and join them with a smooth curve.

[3]

(e) By drawing a tangent, find the gradient of the curve where $x = 8$.

[2]

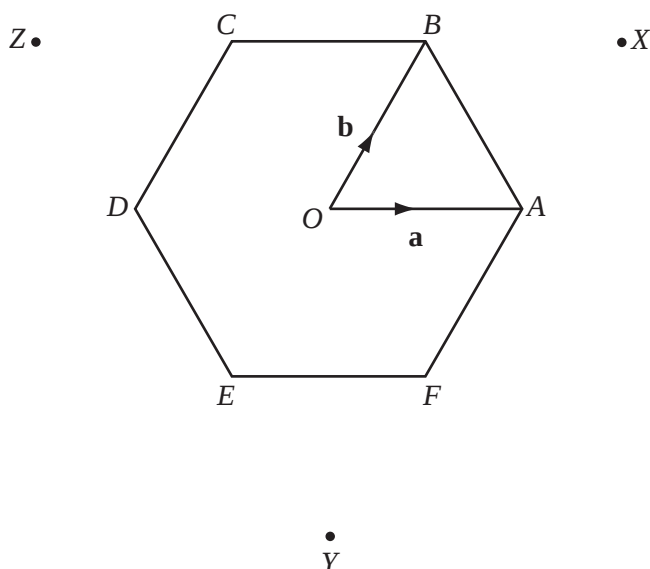
(f) Use your graph to find

(i) the range of values of x for which the area of the lawn is at least 44 m^2 ,

[2]

(ii) the value of x for which the area of the lawn is greatest.

[1]



A regular hexagon, $ABCDEF$, has centre O .

$\vec{OA} = \mathbf{a}$ and $\vec{OB} = \mathbf{b}$.

(a) Express, as simply as possible, in terms of $\mathbf{a}$ and/or $\mathbf{b}$,

(i) $\vec{DO}$, [1]

(ii) $\vec{AB}$, [1]

(iii) $\vec{DB}$. [1]

(b) Explain why $|\mathbf{a}| = |\mathbf{b}| = |\mathbf{b} - \mathbf{a}|$. [1]

(c) The points X , Y and Z are such that

$$\vec{OX} = \mathbf{a} + \mathbf{b}, \quad \vec{OY} = \mathbf{a} - 2\mathbf{b} \quad \text{and} \quad \vec{OZ} = \mathbf{b} - 2\mathbf{a}.$$

(i) Express, as simply as possible, in terms of $\mathbf{a}$ and/or $\mathbf{b}$,

(a) $\vec{AX}$, [1]

(b) $\vec{YX}$. [1]

(ii) What can be deduced about Y , A and X ? [1]

(d) Express, as simply as possible, in terms of $\mathbf{a}$ and/or $\mathbf{b}$, the vector $\vec{XZ}$. [1]

(e) Show that triangle XYZ is equilateral. [2]

(f) Calculate $\frac{\text{Area of triangle } OAB}{\text{Area of triangle } XYZ}$. [2]

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/02

Paper 2

October/November 2006

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
Electronic calculator
Geometrical instruments
Graph paper (2 sheets)
Mathematical tables (optional)

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.

Section B

Answer **four** questions.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

Show all your working on the same page as the rest of the answer.

Omission of essential working will result in loss of marks.

The total of the marks for this paper is 100.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

This document consists of **11** printed pages and **1** blank page.



Section A [52 marks]

Answer **all** the questions in this section.

1 (a) (i) Factorise completely $5x^2 - 20$. [2]

(ii) Simplify $\frac{5x^2 - 20}{10x^2 + 10x - 20}$. [2]

(b) Express as a single fraction in its simplest form

$$\frac{4}{y-3} - \frac{3}{y+5}. \quad [3]$$

(c) Given that $T = 2\pi\sqrt{\frac{L}{g}}$,
express g in terms of π , T and L . [3]

2 The points A and B are $(5, 3)$ and $(13, 9)$ respectively.

(a) Find

(i) the midpoint of AB , [1]

(ii) the gradient of the line through A and B , [1]

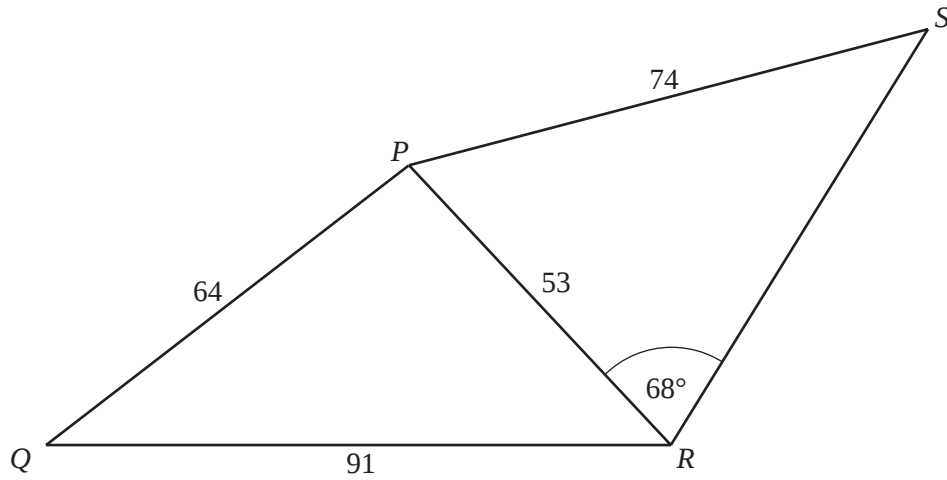
(iii) the length of the line AB . [1]

(b) C is the point $(-8, 5)$.

The point D is such that $\vec{DC} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$.

(i) Find the coordinates of D . [2]

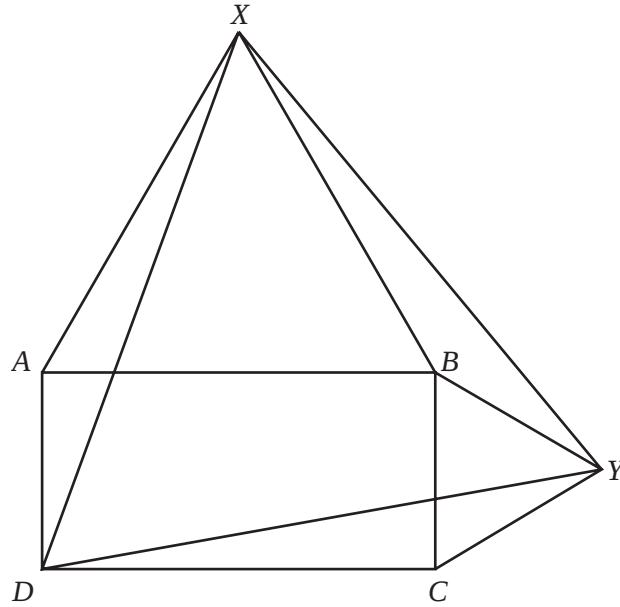
(ii) What type of quadrilateral is $ABCD$? [1]



The diagram shows a footpath PR across a park $PQRS$.
 $PQ = 64$ m, $PR = 53$ m, $PS = 74$ m and $QR = 91$ m.
 Angle $PRS = 68^\circ$.

Calculate

- (a) $\hat{QPR}$, [3]
- (b) $\hat{RPS}$, [3]
- (c) the area of triangle PRS . [2]



The diagram shows a rectangle $ABCD$.

Triangles ABX and BCY are equilateral.

- (a) Find $\hat{XBY}$. [1]
 - (b) Show that triangles AXD and BXY are congruent. [3]
 - (c) Show that $\hat{DXY} = 60^\circ$. [2]
 - (d) Show that triangle DEX is equilateral. [2]
-

- 5 (a) One day the rate of exchange between pounds (£) and United States dollars (\$) was £1 = \$1.65.
On the same day, the rate of exchange between pounds (£) and euros was £1 = 1.44 euros.
- (i) Alan changed £500 into dollars.
Calculate how many dollars he received. [1]
- (ii) Brenda changed 900 euros into pounds.
Calculate how many pounds she received. [1]
- (iii) Clare changed \$792 into euros.
Calculate how many euros she received. [2]
- (b) The cost of manufacturing a television was \$15 000.
- (i) It was sold to a wholesaler at a profit of 8% of the cost.
Calculate the price the wholesaler paid for the television. [1]
- (ii) The wholesaler sold the television to a shop at a profit of 8% of the price he paid for it.
The shop then sold the television to John at a profit of 8% of the price it paid.
Calculate how much the television cost John. [2]
- (iii) Calculate the percentage increase in the cost of the television from its manufacture till John owns it. [2]
- (c) The shop sold a Home Entertainment system to Leslie for \$46 480. The shop made a profit of 12% on the price it paid for the system.
Calculate how much the shop paid for the system. [2]
-
- 6 (a) Solve the equation $7a^2 + 12a - 11 = 0$, giving your answers correct to two decimal places. [4]
- (b) Ann drove for 4 hours at an average speed of x km/h and then for 6 hours at an average speed of y km/h.
She drove a total distance of 816 km.
- (i) Write down an equation in terms of x and y , and show that it simplifies to
$$2x + 3y = 408.$$
 [1]
- (ii) Ken drove for 3 hours at an average speed of x km/h and then for 5 hours at an average speed of y km/h.
He drove a total distance of 654 km.
Write down an equation, in terms of x and y , to represent this information. [1]
- (iii) Solve these two equations to find the value of x and the value of y . [3]
-

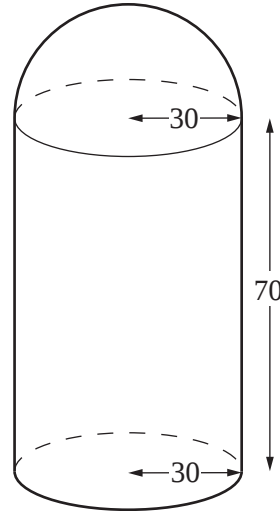
Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

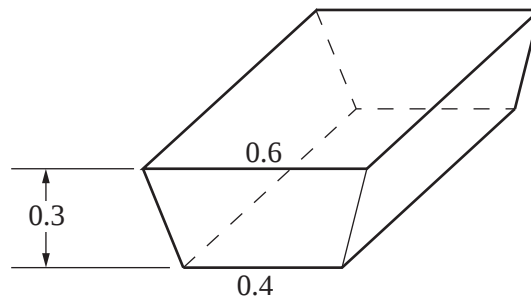
- 7 [Surface area of a sphere = $4\pi r^2$]
[Volume of a sphere = $\frac{4}{3}\pi r^3$]

A hot water tank is made by joining a hemisphere of radius 30 cm to an open cylinder of radius 30 cm and height 70 cm.



- (a) Calculate the total surface area, including the base, of the outside of the tank. [4]
- (b) The tank is full of water.
- (i) Calculate the number of litres of water in the tank. [3]
- (ii) The water drains from the tank at a rate of 3 litres per second.
Calculate the time, in minutes and seconds, to empty the tank. [2]

(iii)



All of the water from the tank runs into a bath, which it just completely fills.

The bath is a prism whose cross-section is a trapezium.

The lengths of the parallel sides of the trapezium are 0.4 m and 0.6 m.

The depth of the bath is 0.3 m.

Calculate the length of the bath.

[3]

- 8 The terms T_1, T_2, T_3, T_4, T_5 of a sequence are given as follows:

$$T_1 = 1 = 1$$

$$T_2 = 3 = 1 + 2$$

$$T_3 = 6 = 1 + 2 + 3$$

$$T_4 = 10 = 1 + 2 + 3 + 4$$

$$T_5 = 15 = 1 + 2 + 3 + 4 + 5$$

- (a) (i) Write down the next two terms, T_6 and T_7 , in the sequence

$$1, 3, 6, 10, 15, \dots \quad [1]$$

- (ii) The n th term in the sequence is given by $T_n = \frac{1}{2} n (n + 1)$.

Show that this formula is true when $n = 7$. [1]

- (iii) Use the formula to find T_{100} . [1]

- (iv) Use your answer to part (iii) to find $5 + 10 + 15 + \dots + 500$. [1]

- (v) Hence find the sum of all the whole numbers from 1 to 500 which are **not** multiples of 5. [2]

- (b) The terms S_1, S_2, S_3, S_4, S_5 of a different sequence are given as follows:

$$S_1 = 1 = 1 \times 1$$

$$S_2 = 4 = 1 \times 2 + 2 \times 1$$

$$S_3 = 10 = 1 \times 3 + 2 \times 2 + 3 \times 1$$

$$S_4 = 20 = 1 \times 4 + 2 \times 3 + 3 \times 2 + 4 \times 1$$

$$S_5 = 35 = 1 \times 5 + 2 \times 4 + 3 \times 3 + 4 \times 2 + 5 \times 1$$

- (i) Find S_6 and S_7 . [2]

- (ii) The n th term in this sequence is given by $S_n = \frac{1}{6} n (n + 1) (n + 2)$.

Show that this formula is true when $n = 7$. [1]

- (iii) Find $1 \times 20 + 2 \times 19 + 3 \times 18 + \dots + 20 \times 1$. [1]

- (c)
$$S_2 - S_1 = (1 \times 2 + 2 \times 1) - 1 \times 1 = 1 \times 2 + 1 \times 1 = 2 + 1 = T_2$$

$$S_3 - S_2 = (1 \times 3 + 2 \times 2 + 3 \times 1) - (1 \times 2 + 2 \times 1) = 3 + 2 + 1 = T_3$$

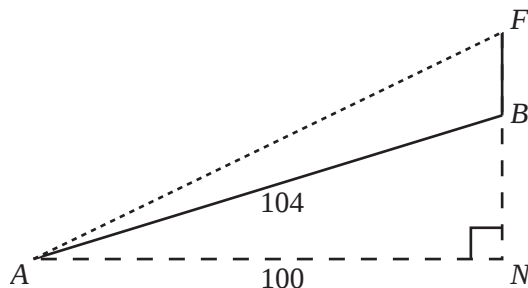
Show that

- (i) $S_4 - S_3 = T_4$, [1]

- (ii) $S_{n+1} - S_n = T_{n+1}$. [1]

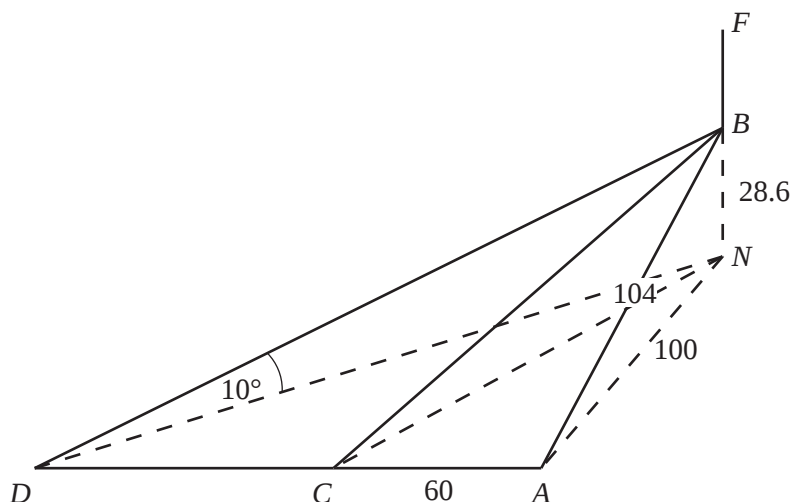
- 9 A vertical flagpole, BF , stands at the top of a hill.
 AB is the steepest path up the hill.
 N lies vertically below B and $\hat{A}NB = 90^\circ$.

$AN = 100$ m and $AB = 104$ m.



- (a) Show that $BN = 28.6$ m. [1]
- (b) It is given that $\hat{FAN} = 25^\circ$.
- (i) Write down the size of the angle of depression of A from F . [1]
- (ii) Calculate the height, BF , of the flagpole. [3]

(c)



The diagram shows three other straight paths (CB , DB and ACD) on the hill.

The path ACD is horizontal and $\hat{BAC} = \hat{NAC} = 90^\circ$.

CN and DN are horizontal lines.

- (i) Given that $AC = 60$ m, calculate $\hat{BCN}$. [4]
- (ii) Given that $\hat{BDN} = 10^\circ$, calculate $\hat{DBA}$. [3]

10 Answer the whole of this question on a sheet of graph paper.

The variables x and y are connected by the equation

$$y = \frac{x^2}{5} + \frac{5}{x}.$$

The table below shows some values of x and the corresponding values of y correct to 1 decimal place.

x	1	1.5	2	3	4	5	6
y	5.2	3.8	3.3	3.5	4.5	6.0	p

(a) Calculate the value of p . [1]

(b) Using a scale of 2 cm to represent 1 unit on each axis, draw a horizontal x -axis for $0 \leq x \leq 6$ and a vertical y -axis for $0 \leq y \leq 9$.

On your axes, plot the points given in the table and join them with a smooth curve. [3]

(c) Use your graph to find the values of x in the range $1 \leq x \leq 6$ for which $\frac{x^2}{5} + \frac{5}{x} - 4 = 0$. [2]

(d) By drawing a tangent, find the gradient of the curve at the point (4, 4.5). [2]

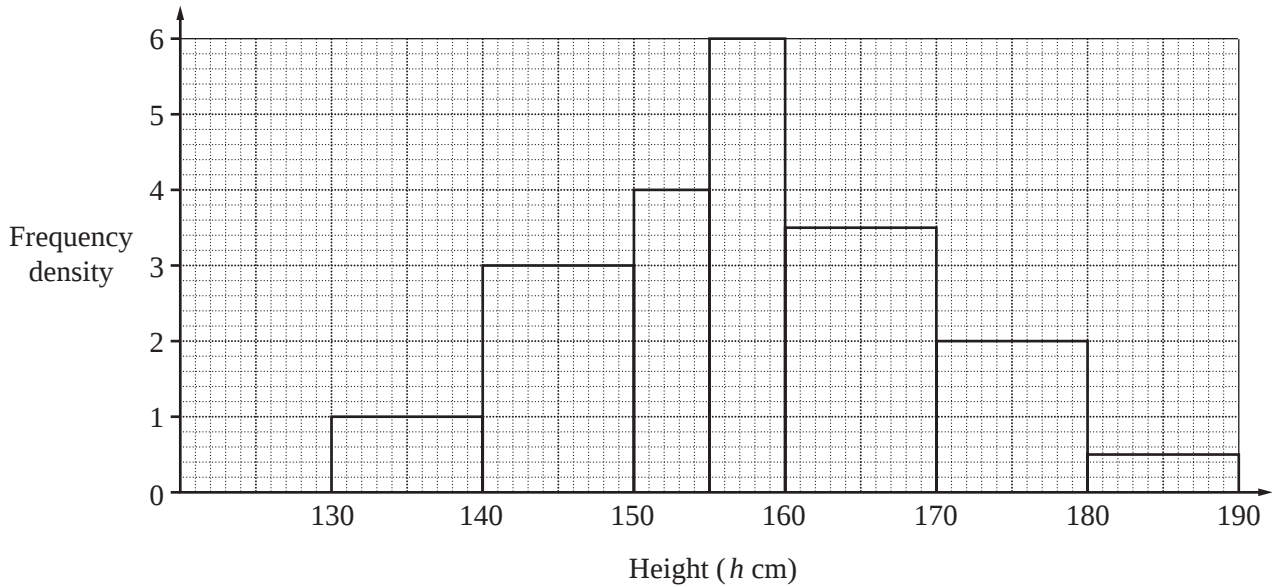
(e) (i) On the same axes, draw the graph of $y = \frac{1}{2}x + 3$. [2]

(ii) Write down the x coordinates of the points at which the two graphs intersect. [1]

(iii) Find the equation, in the form $2x^3 + ax^2 + bx + c = 0$, which is satisfied by the values of x found in part **(e)(ii)**. [1]

11 Answer the whole of this question on a sheet of graph paper.

The diagram shows the histogram which represents the heights of the pupils in a small school.



- (a) (i) On your graph paper, copy and complete this frequency table that represents the distribution.**

$130 < h \leq 140$	$140 < h \leq 150$	$150 < h \leq 155$	$155 < h \leq 160$	$160 < h \leq 170$	$170 < h \leq 180$	$180 < h \leq 190$
10						

[2]

- (ii) Hence copy and complete this cumulative frequency table that represents the distribution.**

Height (h cm)	≤ 130	≤ 140	≤ 150	≤ 155	≤ 160	≤ 170	≤ 180	≤ 190
Cumulative frequency	0	10						

[1]

- (b)** Using a scale of 2 cm to represent 10 cm, draw a horizontal h -axis for $130 \leq h \leq 190$.
Using a scale of 1 cm to represent 10 pupils, draw a vertical axis.

On your axes, draw a smooth cumulative frequency curve to illustrate the information.

[3]

- (c)** Use your graph to find

(i) the median height of the pupils,

[1]

(ii) the lower quartile height,

[1]

(iii) the interquartile range.

[1]

- (d) One student is chosen at random.

Use the frequency table to find the probability that the student's height is greater than 160 cm.
Give your answer as a fraction in its lowest terms.

[1]

- (e) Two students are chosen at random.

Calculate the probability that one has a height greater than 170 cm and the other has a height at most 140 cm.

Give your answer as a fraction.

[2]

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/02

Paper 2

October/November 2007

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
Electronic calculator
Geometrical instruments

Graph paper (2 sheets)
Mathematical tables (optional)

READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

Show all your working on the same page as the rest of the answer.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions. You may use mathematical tables as well if necessary.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

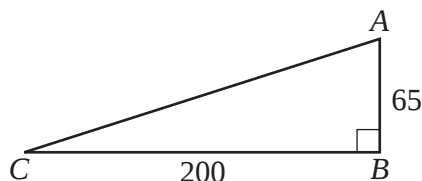
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Section A [52 marks]

Answer **all** the questions in this section.

1 (a)

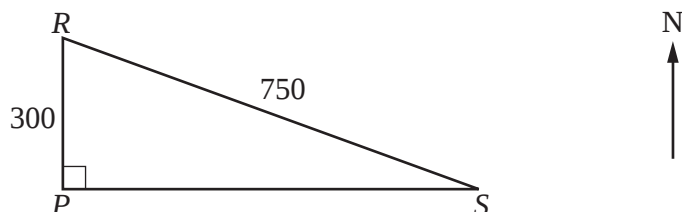


From the top of a vertical tower, AB , an observer sees a car at C .
 $AB = 65$ m and $CB = 200$ m.

Calculate $\hat{CAB}$.

[2]

(b)



The diagram shows three positions at sea, R , P and S .

R is due north of P and S is due east of P .

$RP = 300$ m and $RS = 750$ m.

- (i) A boat sailed at a constant speed of 5 km/h from R to S .
 It was at R at 22 56.

Find the time it reached S .

[3]

- (ii) Calculate the bearing of S from R .

[3]

2 (a) It is given that $x = a + \sqrt{a^2 + b^2}$.

- (i) Calculate x when $a = 0.73$ and $b = 1.84$.
 Give your answer correct to 2 decimal places.

[2]

- (ii) Express b in terms of x and a .

[3]

(b) A shopkeeper sells pens and pencils.

Each pen costs \$5 and each pencil costs \$3.

One day he sold x pens.

On the same day he sold 9 more pens than pencils.

- (i) Write down an expression, in terms of x , for his total income from the sale of these pens and pencils.

[2]

- (ii) This total income was less than \$300.

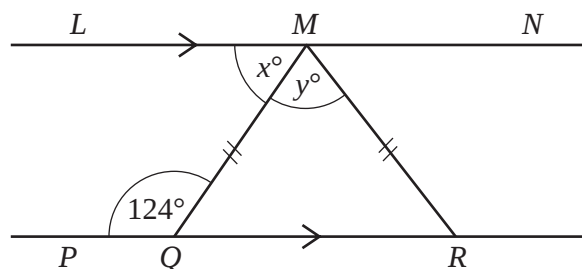
Form an inequality in x and solve it.

[2]

- (iii) Hence write down the maximum number of pens that he sold.

[1]

3 (a)

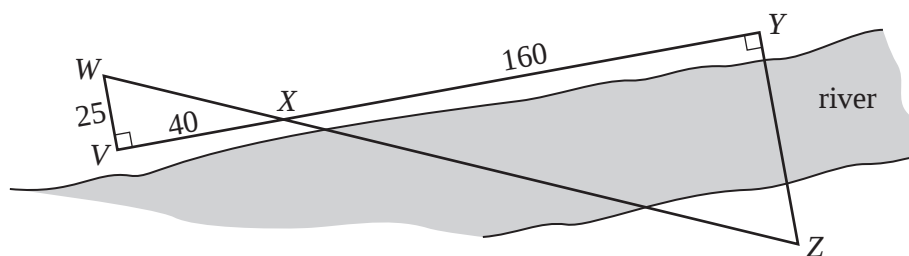


In the diagram, LMN is parallel to PQR .
 Angle $PQM = 124^\circ$ and $MQ = MR$.

Find

- (i) x , [1]
 (ii) y . [1]

- (b) In a surveying exercise to find the distance between two points, Y and Z , on opposite banks of a river, angles and lengths were measured.



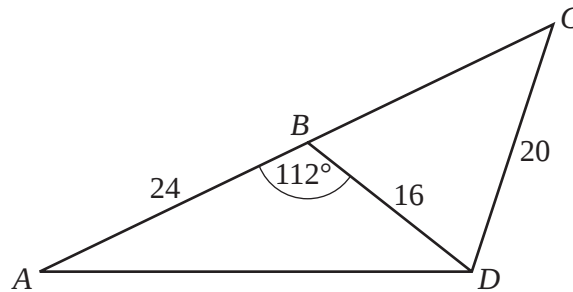
WXZ and VXY are straight lines.
 $\widehat{WXV} = \widehat{ZYX} = 90^\circ$.

- (i) Show that triangles VWX and YZX are similar. [2]
 (ii) $VW = 25$ m, $VX = 40$ m and $XY = 160$ m.

Calculate the distance YZ . [2]

- 4 (a) In 2005, the cost of posting a letter was 28 cents.
A company posted 1200 letters and was given 4% discount on the cost.
- Calculate the total discount. [1]
- (b) In 2006, the cost of posting a letter was increased from 28 cents to 35 cents.
- Calculate the percentage increase in the cost of posting a letter. [2]
- (c) After the price increase to 35 cents, the cost to the company of posting 1200 letters was \$399.
- Calculate the percentage discount that the company was given in 2006. [2]
- (d) In 2006, it cost \$4.60 to post a parcel.
This was an increase of 15% on the cost of posting the parcel in 2005.
- Calculate the cost of posting this parcel in 2005. [3]
-

5



The points A , B , C and D represent four towns on a map.
 ABC is a straight line.
 $AB = 24\text{ cm}$, $BD = 16\text{ cm}$ and $CD = 20\text{ cm}$.
Angle $ABD = 112^\circ$.

- (a) Calculate
- (i) AD , [4]
 - (ii) angle BCD , [3]
 - (iii) the area of triangle ABD . [2]
- (b) The scale of the map is 1 : 250 000.
- Calculate the actual distance, in kilometres, from town A to town B . [1]
-

- 6 (a) **Diagram I** shows a design which consists of 7 congruent circles drawn inside a large circle. The circles touch at all the points shown.

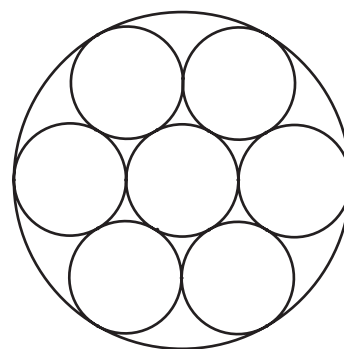


Diagram I

- (i) State the order of rotational symmetry of this design. [1]
- (ii) In **Diagram II**, two sections of the design have been shaded. Each small circle has a radius of 5 cm.

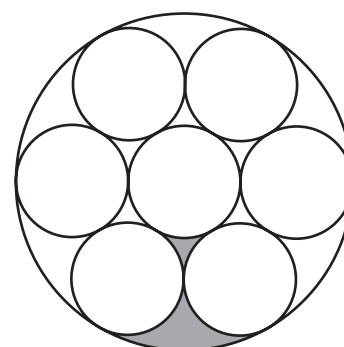


Diagram II

Calculate

- (a) the area of the large circle, [2]
- (b) the shaded area. [2]
- (b) In **Diagram III**, circles, centres O , A and B , are shown, together with the same shaded area. O is also the centre of the large circle.

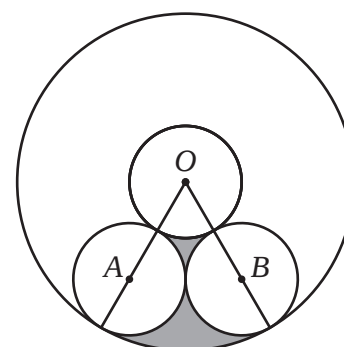


Diagram III

- (i) Write down angle AOB . [1]
- (ii) Calculate the **total** perimeter of the shaded area. [4]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

- 7 (a) Compost for growing plants consists of 3 parts of soil to 2 parts of sand to 1 part of peat.

(i) Calculate the number of litres of sand in a 75 litre bag of compost. [2]

(ii) Compost is sold in 5 litre, 25 litre and 75 litre bags costing \$2, \$8.75 and \$27 respectively.

Showing your working clearly, state which bag represents the best value for money. [2]

- (b) [The volume of a cone = $\frac{1}{3} \times \text{base area} \times \text{height}$.]

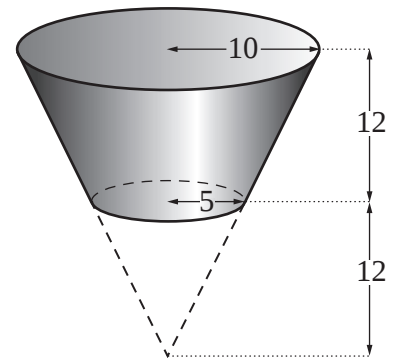
The diagram shows a plant pot.

The open end of the plant pot is a circle of radius 10 cm.

The closed end is a circle of radius 5 cm.

The height of the plant pot is 12 cm.

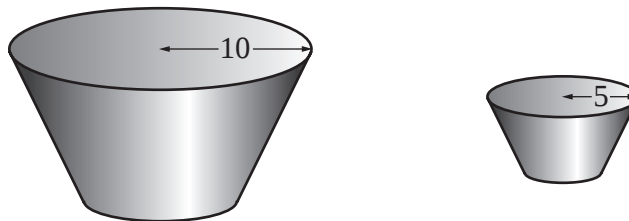
The plant pot is part of a right circular cone of height 24 cm.



(i) Calculate the volume of the plant pot.
Give your answer in litres. [4]

(ii) How many of these plant pots can be completely filled from a 75 litre bag of compost? [2]

(iii) A smaller plant pot is geometrically similar to the original plant pot.
The open end of this plant pot is a circle of radius 5 cm.



How many of these plant pots can be completely filled from a 75 litre bag of compost? [2]

8 Answer the whole of this question on a sheet of graph paper.

A stone was thrown from the top of a vertical cliff. Its position during the flight is represented by the equation $y = 24 + 10x - x^2$, where y metres is the height of the stone above the sea and x metres is the horizontal distance from the cliff.

(a) Solve the equation $0 = 24 + 10x - x^2$. [2]

(b) The table shows some values of x and the corresponding values of y .

x	0	2	4	6	8	10
y	24	40	48	48	40	24

(i) Using a scale of 1 cm to represent 1 metre, draw a horizontal x -axis for $0 \leq x \leq 14$.
Using a scale of 2 cm to represent 10 metres, draw a vertical y -axis for $0 \leq y \leq 50$.

On your axes, plot the points from the table and join them with a smooth curve. [3]

(ii) Use your answer to part **(a)** to complete the graph which represents the flight of the stone. [1]

(iii) Find the height of the stone above the sea when its horizontal distance from the cliff was 7 m. [1]

(iv) Use your graph to find how far the stone travelled horizontally while it was 6 m or more above the top of the cliff. [2]

(c) It is given that $24 + 10x - x^2 = p - (x - 5)^2$.

(i) Find the value of p . [1]

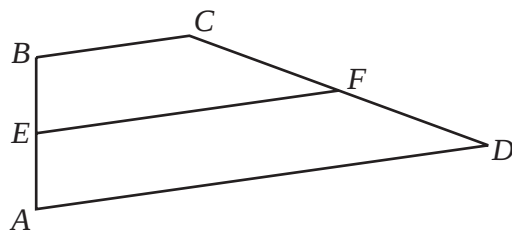
(ii) Hence find

(a) the greatest height of the stone above the sea, [1]

(b) the horizontal distance from the cliff when the stone was at its greatest height. [1]

- 9 (a) Given that $\overrightarrow{PQ} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$, $\overrightarrow{QR} = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$ and $\overrightarrow{RS} = \begin{pmatrix} 1 \\ -5 \end{pmatrix}$, find $\overrightarrow{PS}$. [1]

(b)



In the diagram, $\overrightarrow{AB} = 2\mathbf{b}$, $\overrightarrow{AD} = 3\mathbf{a}$ and $\overrightarrow{DF} = \mathbf{b} - \mathbf{a}$.
 E is the midpoint of AB and F is the midpoint of DC .

- (i) Express, as simply as possible, in terms of $\mathbf{a}$ and/or $\mathbf{b}$,

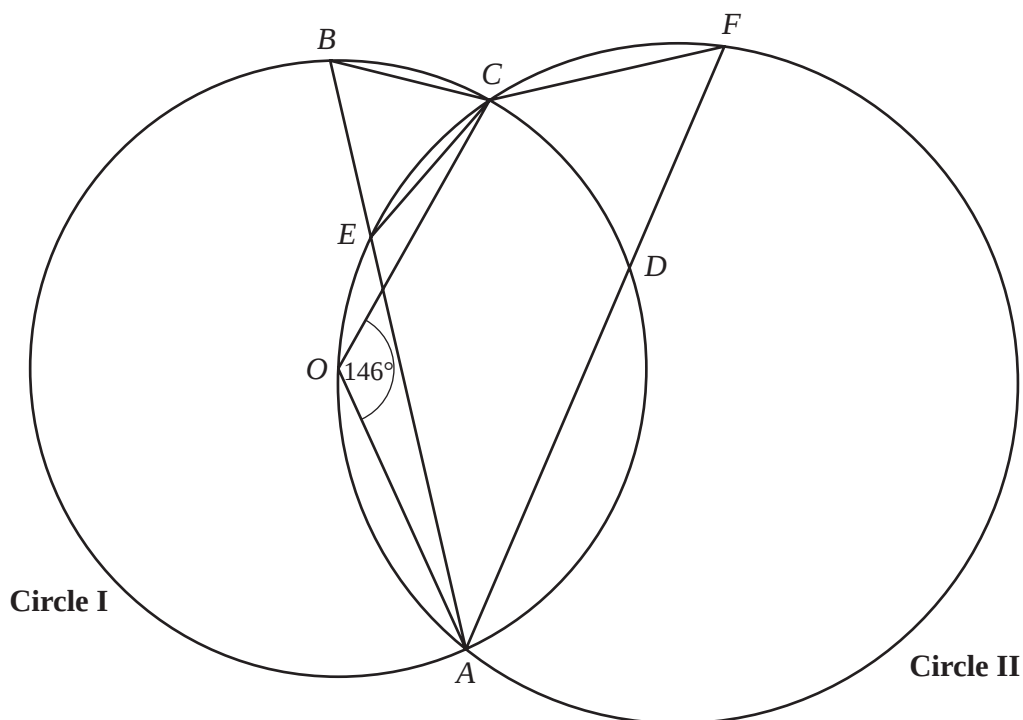
- (a) $\overrightarrow{EA}$, [1]
 (b) $\overrightarrow{DC}$, [1]
 (c) $\overrightarrow{EF}$, [1]
 (d) $\overrightarrow{BC}$. [1]

- (ii) (a) Give the special name of the quadrilateral $ABCD$.

Give your reason. [2]

- (b) Find the ratio $|\overrightarrow{BC}| : |\overrightarrow{EF}| : |\overrightarrow{AD}|$. [1]

(c)



Points A , B , C and D lie on **Circle I**.

O is the centre of **Circle I**.

Points A , O , E , C and F lie on **Circle II**.

AEB and ADF are straight lines.

Angle $AOC = 146^\circ$.

Giving your reasons, write down

- | | |
|---------------------|-----|
| (i) $\hat{CEA}$, | [1] |
| (ii) $\hat{CBA}$, | [1] |
| (iii) $\hat{CFA}$, | [1] |
| (iv) $\hat{DCF}$. | [1] |
-

10 Answer the whole of this question on a sheet of graph paper.

Potatoes are sold in sacks.

One sack, picked at random, contained 260 potatoes.

The masses, in grams, of the potatoes in this sack are summarised in the table below.

Mass (m grams)	$50 < m \leq 100$	$100 < m \leq 150$	$150 < m \leq 200$	$200 < m \leq 250$	$250 < m \leq 300$	$300 < m \leq 350$
Frequency	4	56	84	76	36	4

(a) (i) Calculate an estimate of the total mass of the potatoes in this sack. [2]

(ii) Calculate an estimate of the mean mass, in grams, of a potato. [1]

(b) (i) **Copy and complete** the cumulative frequency table given below.

Mass (m grams)	$m \leq 50$	$m \leq 100$	$m \leq 150$	$m \leq 200$	$m \leq 250$	$m \leq 300$	$m \leq 350$
Cumulative frequency	0	4	60				260

[1]

(ii) Using a scale of 2 cm to represent 50 grams, draw a horizontal axis for masses between 0 and 350 grams.
Using a scale of 2 cm to represent 50 potatoes, draw a vertical axis for values from 0 to 300.

On your axes, draw a smooth cumulative frequency curve to illustrate this information. [3]

(iii) Use your curve to find

(a) the median, [1]

(b) the interquartile range. [2]

(c) The organisers of a barbecue expect to sell 500 baked potatoes.
Each potato should have a mass greater than 200 g.

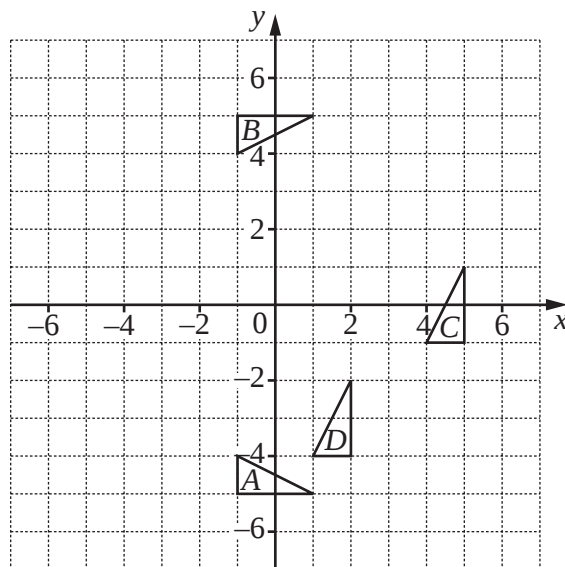
Estimate the number of sacks of potatoes they will need. [2]

- 11 (a) P is the point $(2, 9)$ and Q is the point $(4, 6)$.

Find

- (i) the length of PQ , [2]
 (ii) the equation of the line PQ . [2]

(b)



The diagram shows triangles A , B , C and D .

- (i) Find the matrix representing the transformation that maps triangle A onto triangle B . [1]
 (ii) Describe fully the **single** transformation that maps triangle B onto triangle C . [2]
 (iii) Triangle C is mapped onto triangle D by the translation T .
 (a) Write down the column vector that represents T . [1]
 (b) The transformation R that maps triangle A onto triangle C is represented by the matrix $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$.
 Show that the transformation R followed by T maps (h, k) onto $(-k-3, h-3)$. [1]
 (c) Find the value of h and the value of k for which the transformation R followed by T maps (h, k) onto itself. [2]
 (d) The **single** transformation that is equivalent to R followed by T is a rotation.
 Write down the coordinates of the centre of this rotation. [1]

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/02

Paper 2

October/November 2008

2 hours 30 minutes

Additional Materials:

Answer Booklet/Paper
Electronic calculator
Geometrical instruments

Graph paper (2 sheets)
Mathematical tables (optional)



READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

Show all your working on the same page as the rest of the answer.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions. You may use mathematical tables as well if necessary.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

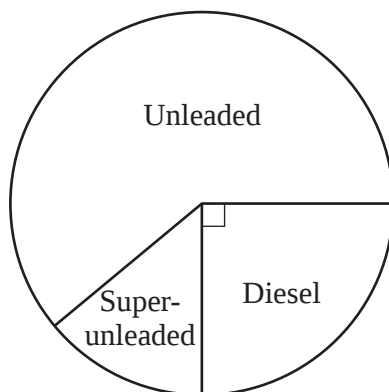
This document consists of **11** printed pages and **1** blank page.



Section A [52 marks]

Answer **all** questions in this section.

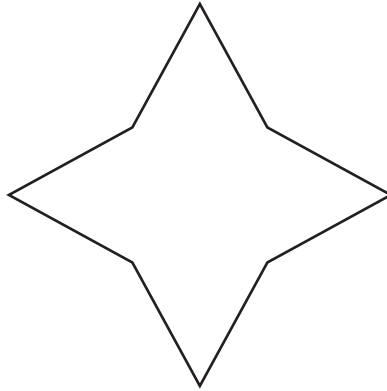
- 1 (a) In 2006 the cost of fuel was 91.8 cents per litre.
- (i) Calculate the maximum number of whole litres that could be bought for \$15. [1]
- (ii) In 2007 the cost of fuel was increased by 4 cents per litre.
- (a) Calculate the percentage increase in the cost of fuel in 2007. [2]
- (b) On average, a car travelled 21 km on 1 litre of fuel.
During 2006 this car travelled 19 200 km.
In 2007 the car travelled the same distance.
Calculate the extra cost for fuel in 2007.
Give your answer to the nearest dollar. [2]
- (iii) In 2006 the cost of fuel was 10% less than the cost in 2005.
Calculate the cost, in cents, per litre in 2005. [2]
- (b) A service station sells unleaded, super-unleaded and diesel fuel.
The pie chart represents the amounts of these fuels sold during one week.



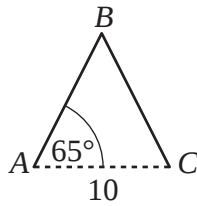
The total amount of fuel sold during this week was 54 000 litres.

- (i) How many litres of diesel were sold? [1]
- (ii) The amount of unleaded fuel sold was $\frac{2}{3}$ of the total for the week.
How many litres of super-unleaded fuel were sold? [2]
-

- 2 Eight straight paths in a level garden form this shape with rotational symmetry of order four.



(a)

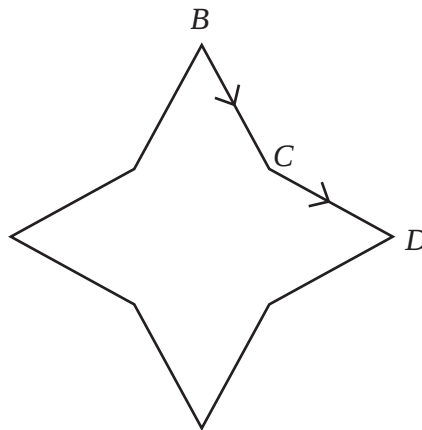


The two paths shown, AB and BC , form part of the isosceles triangle ABC .
 $AC = 10\text{m}$ and angle $BAC = 65^\circ$.

Calculate

- (i) the length of the path AB , [2]
- (ii) the area of triangle ABC , [2]
- (iii) the area of garden enclosed by all 8 paths. [2]

(b)



Ada walked along the paths BC and CD .

- (i) Calculate $\hat{BCD}$. [2]
- (ii) After walking in the direction BC , Ada turned to walk in the direction CD .
 State the value of the angle through which she turned. [1]

3 (a) Solve the equation $\frac{2p+1}{3} = 1 + \frac{p-3}{2}$. [3]

(b) Simplify $\frac{2v-6}{v^2-2v-3}$. [3]

(c) The tens digit of a number is x and the units digit is y .

Hence the value of the number is $10x + y$.

For example, if $x = 5$ and $y = 6$, the number would be $10 \times 5 + 6 = 56$.

(i) When the digits x and y are reversed, the value of the number is increased by 63.

Show that $y - x = 7$. [2]

(ii) The sum of the original number and the number with reversed digits is 99.

(a) Show that $x + y = 9$. [1]

(b) Hence find the value of x and the value of y . [2]

4 Answer the whole of this question on a sheet of graph paper.

The heights of 120 children were measured.

The results are summarised in the table below.

Height (h cm)	$135 < h \leq 140$	$140 < h \leq 145$	$145 < h \leq 150$	$150 < h \leq 155$	$155 < h \leq 160$	$160 < h \leq 180$
Frequency	15	20	25	30	20	10

(a) Using a scale of 1 cm to represent 5 cm, draw a horizontal axis for heights from 135 cm to 180 cm. Using a scale of 2 cm to represent 1 unit, draw a vertical axis for frequency densities from 0 to 6 units.

On your axes, draw a histogram to represent the information in the table. [3]

(b) Estimate how many children have heights greater than 170 cm. [1]

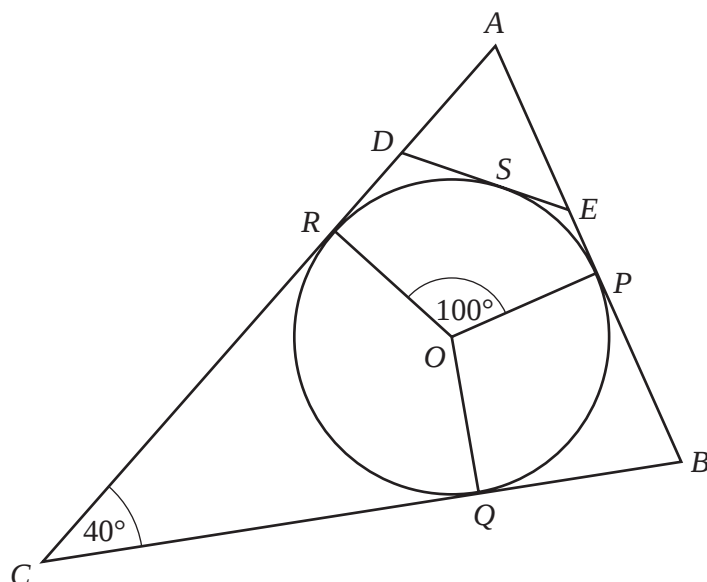
(c) One child was chosen at random.

Find the probability that the height of this child was less than or equal to 140 cm.

Give your answer as a fraction in its lowest terms. [1]

(d) Two children were chosen at random.

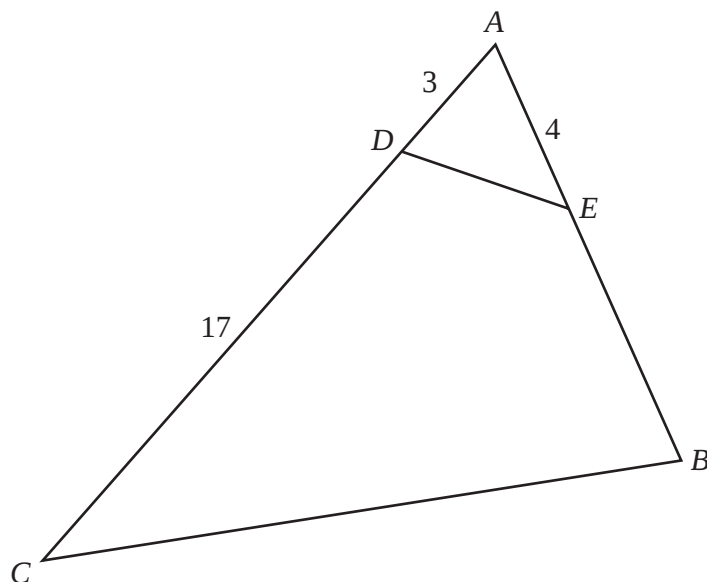
Find the probability that they both had heights in the range $150 < h \leq 155$. [2]



The diagram shows a circle, centre O .

The lines AB , BC and CA touch the circle at P , Q and R respectively.

- (a) (i) Explain why $\angle CQO = 90^\circ$. [1]
 (ii) Given that $\angle ACB = 40^\circ$, find $\angle ROQ$. [1]
- (b) The line DE touches the circle at S .
 The triangles ABC and ADE are similar.
- (i) Write down the value of $\angle AED$. [1]
 (ii) Given that $\angle ROP = 100^\circ$, find $\angle ROS$. [2]
 (iii)



Given also that $AD = 3$ cm, $CD = 17$ cm and $AE = 4$ cm, calculate BE .

[2]

- 6 (a) Each diagram in the sequence below consists of a number of dots.

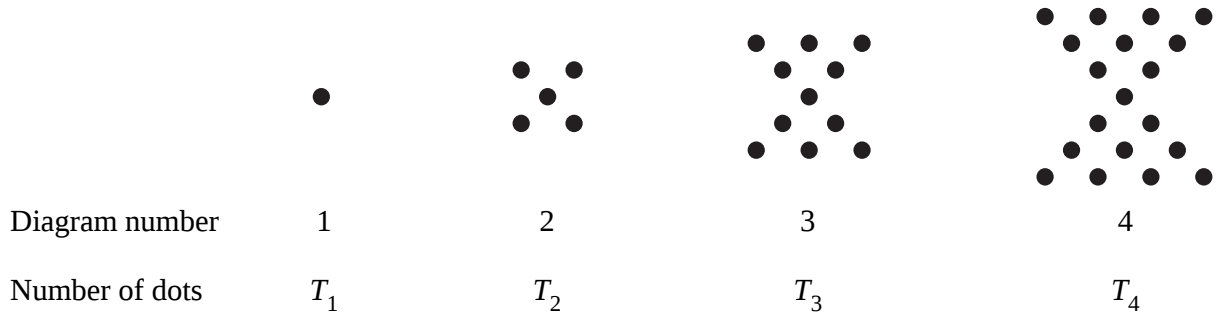


Diagram number (n)	1	2	3	4	5
Number of dots (T_n)	1	5	11	p	q

- (i) Write down the value of p . [1]
- (ii) Find the value of q . [1]

- (b) Another sequence of patterns of dots is shown below.

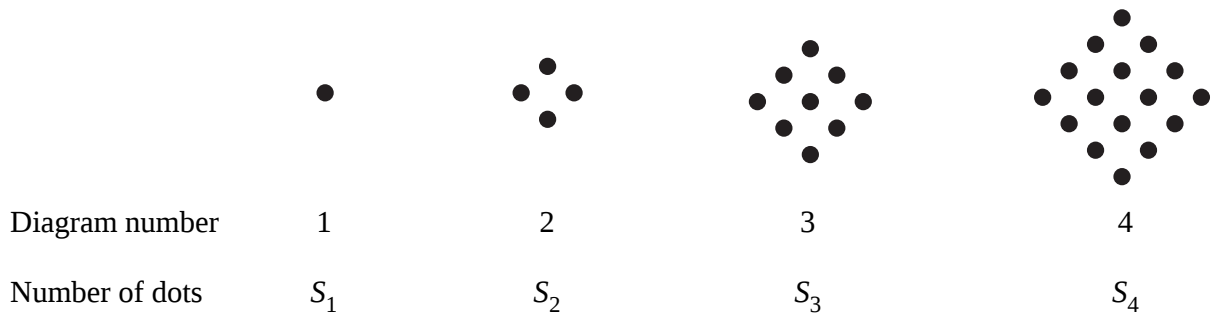


Diagram number (n)	1	2	3	4	5
Number of dots (S_n)	1	4	9	j	k

- (i) Write down the value of j . [1]
- (ii) Find the value of k . [1]
- (iii) Express S_n in terms of n . [1]

- (c) Another sequence is formed whose n th term U_n is $T_n - S_n$.

$$U_1 = T_1 - S_1 = 1 - 1 = 0, \quad U_2 = T_2 - S_2 = 5 - 4 = 1, \quad U_3 = T_3 - S_3 = 11 - 9 = 2, \quad \dots\dots\dots$$

- (i) Evaluate U_4 and U_5 . [1]
- (ii) Express U_n in terms of n . [1]
- (iii) Hence, using your expression for S_n found in (b)(iii), express T_n in terms of n . [1]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

7 A light aircraft flew from Maseru to Nata and returned to Maseru.

(a) The distance from Maseru to Nata is 1080 km.

(i) On the outward flight, the average speed of the aircraft was x kilometres per hour.

Write down an expression, in terms of x , for the time taken in hours. [1]

(ii) On the return flight, the average speed was 30 km/h greater than the average speed on the outward flight.

Write down an expression, in terms of x , for the time taken, in hours, on the return flight. [1]

(b) The time taken on the return flight was half an hour less than the time taken on the outward flight.

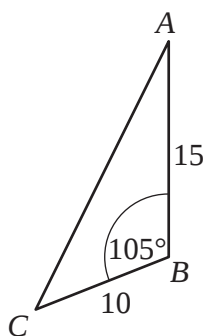
Form an equation in x and show that it reduces to $x^2 + 30x - 64800 = 0$. [3]

(c) Solve the equation $x^2 + 30x - 64800 = 0$. [4]

(d) Calculate

(i) the time taken, in hours, on the outward flight, [1]

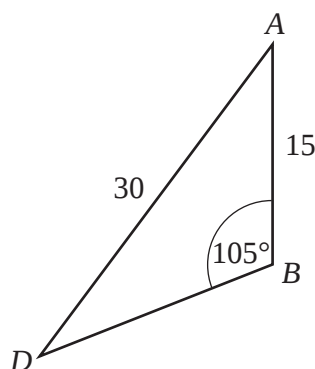
(ii) the average speed for the whole flight from Maseru to Nata and back to Maseru. [2]



C is a point on a slope with highest point B , where $CB = 10$ m.
A vertical mast, AB , of height 15 m stands at B and $\hat{ABC} = 105^\circ$.
 AC is one of the wires that supports the mast.

- (a) (i) Write down the angle between CB and the horizontal. [1]
(ii) Calculate the length of the wire AC . [4]

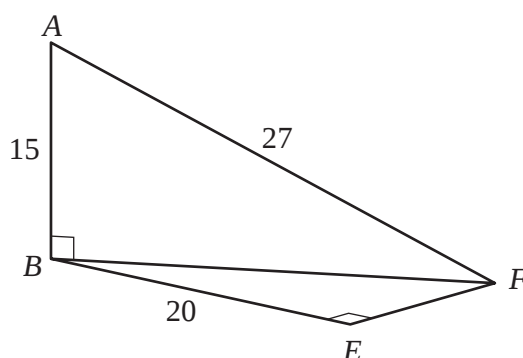
(b)



D is another point further down the slope.
 AD is another supporting wire.

Given that $AD = 30$ m, calculate $\hat{ADB}$. [3]

(c)

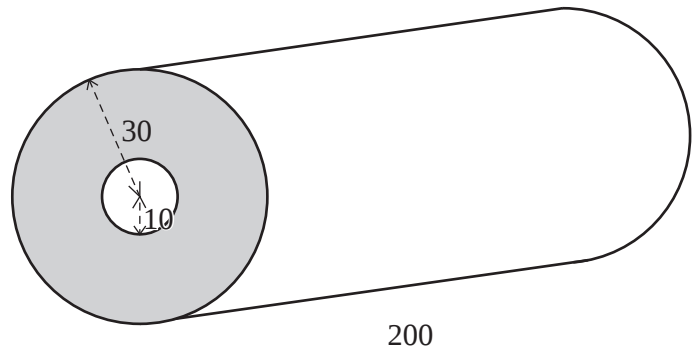


The points B , E and F are on horizontal ground at the top of the slope.
The mast is supported by another wire AF .
 $\hat{BEF} = 90^\circ$, $AF = 27$ m and $BE = 20$ m.

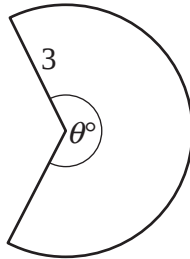
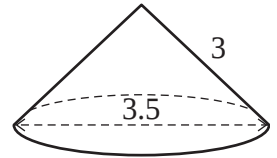
Calculate

- (i) EF , [2]
(ii) the angle of elevation of the top of the mast from F . [2]

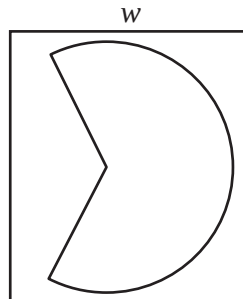
- 9 (a) The diagram shows a roll of material. The material is wound onto a metal cylinder whose cross-section is a circle of radius 10 cm. The shaded area shows the cross-section of the material on the roll. The outer layer of material forms the curved surface of a cylinder of radius 30 cm.



- (i) Calculate, in square centimetres, the area of the cross-section of the material on the roll (shaded on the diagram). [2]
- (ii) The material is 200 cm wide on the roll. Calculate, **in cubic metres**, the volume of the material. [2]
- (iii) When unwound, the length of the material is 150 m. Calculate the thickness of the material, giving your answer in millimetres. [2]
- (b) The diagram shows a conical tent. The diameter of the base is 3.5 m and the slant height is 3 m. It is made from a flat piece of canvas that forms a sector of a circle of radius 3 m. The angle at the centre is θ° .



- (i) Show that $\theta = 210$. [3]
- (ii) As shown, the required shape is cut from a rectangular piece of canvas of width w metres.



Given that w is a whole number, find its least possible value. Show all your working. [3]

10 Answer the whole of this question on a sheet of graph paper.

The number of bacteria in a colony doubles every half hour.

The colony starts with 50 bacteria.

The table below shows the number of bacteria in the colony after t hours.

Time (t hours)	0	0.5	1	1.5	2	2.5	3	3.5
Number of bacteria (y)	50	100	200	400	800	1600	3200	6400

- (a) Using a scale of 4 cm to represent 1 hour, draw a horizontal t -axis for $0 \leq t \leq 4$.
Using a scale of 2 cm to represent 1000 bacteria, draw a vertical y -axis for $0 \leq y \leq 7000$.
On your axes, plot the points given in the table, and join them with a smooth curve. [3]
- (b) Use your graph to find the number of bacteria in the colony when $t = 2.75$. [1]
- (c) (i) By drawing a tangent, find the gradient of the graph when $t = 2.5$. [2]
(ii) State briefly what this gradient represents. [1]
- (d) The number of bacteria in another colony is given by the equation

$$y = 6500 - 1000t.$$
 (i) On the same axes, draw a graph to represent the number of bacteria in this colony. [2]
 (ii) Find the value of t when the number of bacteria in each colony is the same. [1]
- (e) Given that the equation of the first graph is $y = ka^t$, find the value of
 (i) k , [1]
 (ii) a . [1]
-

11 (a) $\vec{PQ} = \begin{pmatrix} 12 \\ -35 \end{pmatrix}$ and $\vec{QR} = \begin{pmatrix} 4 \\ 14 \end{pmatrix}$.

(i) Find

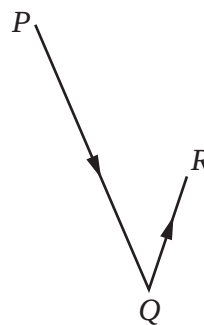
(a) $|\vec{PQ}|$,

(b) $\vec{PR}$.

(ii) Given that T is the midpoint of QR , find $\vec{PT}$.

(iii) $PQRS$ is a parallelogram.
The coordinates of R are $(6, 16)$.

Find the coordinates of S .



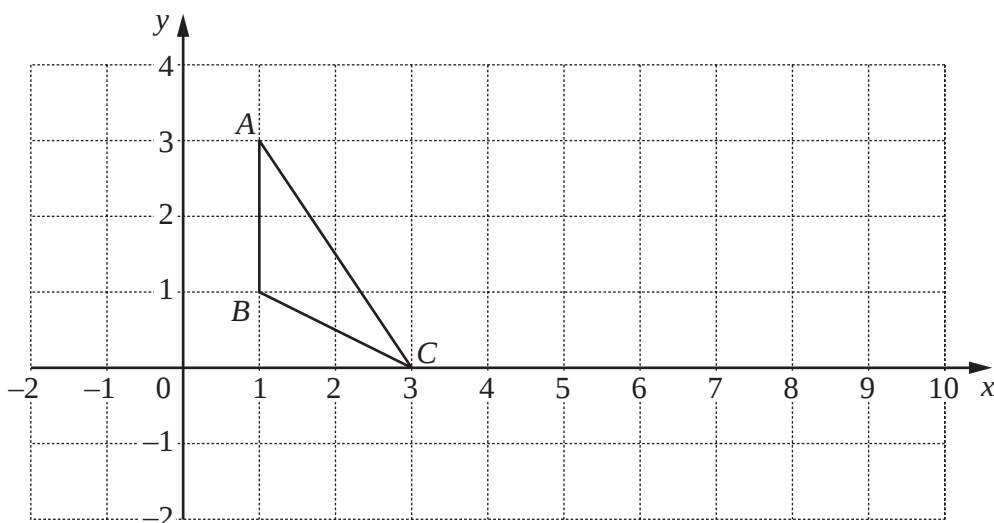
[1]

[1]

[2]

[2]

(b)



The diagram shows triangle ABC .

(i) Find the area of triangle ABC .

(ii) An enlargement, scale factor 4, maps triangle ABC onto triangle LMN .
The point A maps onto the point $L(10, 3)$.

(a) Find the coordinates of the centre of enlargement.

(b) Write down the area of triangle LMN .

(iii) A shear, with the x -axis invariant, maps triangle ABC onto triangle DEF .
The point A maps onto the point $D(7, 3)$.

(a) Find the coordinates of E , the image of B .

(b) Write down the area of triangle DEF .

[1]

[1]

[1]

[2]

[1]

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/02

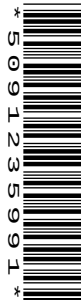
Paper 2

October/November 2009

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
Electronic calculator
Geometrical instruments

Graph paper (2 sheets)
Mathematical tables (optional)



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Section A

Answer **all** questions.

Section B

Answer any **four** questions.

Show all your working on the same page as the rest of the answer.

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The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **10** printed pages and **2** blank pages.



Section A [52 marks]

Answer **all** questions in this section.

1 Solve the equations

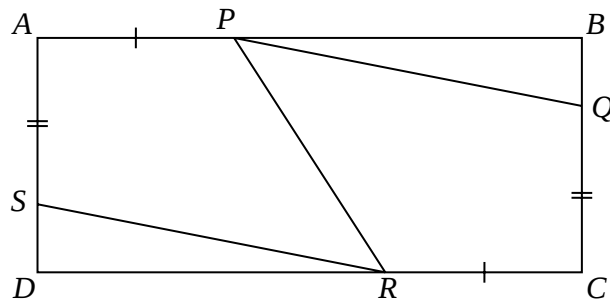
(a) $2^y = 8$, [1]

(b) $3p + 4 = 8 - 2(p - 3)$, [2]

(c) $\frac{18}{q} - \frac{16}{q+2} = 1$, [3]

(d) $5x^2 + x - 7 = 0$, giving each solution correct to 2 decimal places. [4]

2



$ABCD$ is a rectangle.

Points P , Q , R and S lie on AB , BC , CD and DA respectively such that $AP = CR$ and $QC = SA$.

(a) Giving reasons, show that

(i) $PB = RD$, [1]

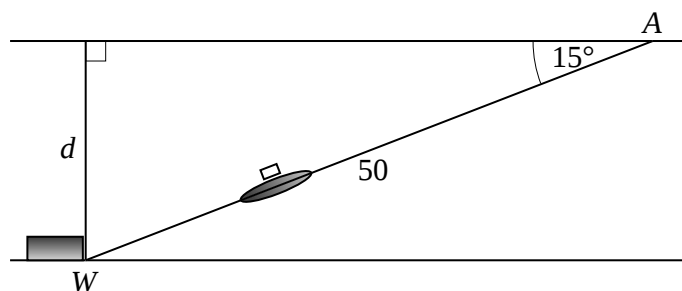
(ii) triangle PBQ is congruent to triangle RDS , [3]

(iii) $\hat{RPQ} = \hat{RSQ}$. [3]

(b) State the special name of the quadrilateral $PQRS$. [1]

- 3 A small submarine dived in a straight line from a point A on the surface to examine an object at the point W on the seabed.

(a)

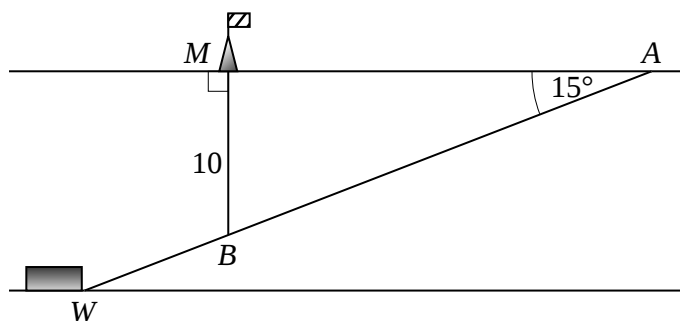


It dived at an angle of 15° to the horizontal and reached W after travelling 50 m.

Calculate the depth, d metres, of the seabed at W .

[2]

(b)



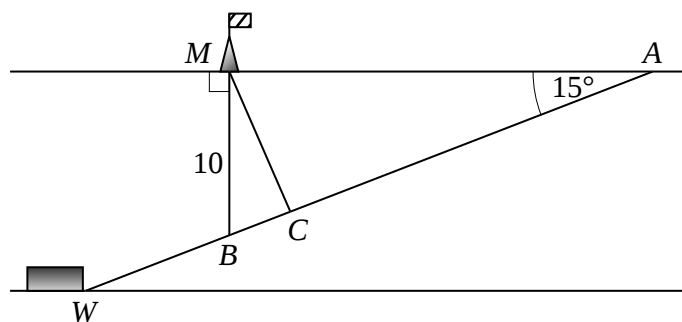
A marker is at the point M on the surface.

When at B , the submarine was 10 m vertically below M .

Calculate AB .

[3]

(c)



When at C , the submarine was at its nearest point to M .

(i) Find $\hat{BMC}$.

[1]

(ii) Calculate CM .

[2]

- 4 (a) $\mathcal{C} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15\}$

$$L = \{x : x \text{ is an odd number}\}$$

$$M = \{x : x \text{ is a multiple of 3}\}$$

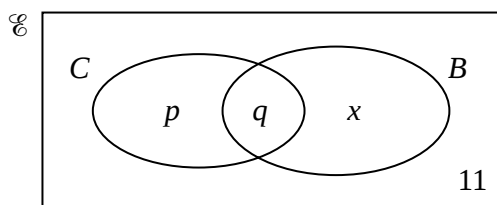
- (i) Write down

(a) $L \cap M$, [1]

(b) $L' \cap M$. [1]

- (ii) A number n is chosen at random from $\mathcal{C}$.
Find the probability that $n \in L \cup M$. [1]

- (b) In a survey, a number of people were asked “Do you own a car?” and “Do you own a bicycle?”.
The Venn diagram shows the set C of car owners and the set B of bicycle owners.
The letters p , q and x are the numbers of people in each subset.
11 people owned neither a car nor a bicycle.



A total of 66 people owned a car.

4 times as many people owned a car **only** as owned a bicycle **only**.

- (i) Write down expressions, in terms of x , for

(a) p , [1]

(b) q . [1]

- (ii) A total of 27 people owned a bicycle.

Calculate

(a) x , [2]

(b) the **total** number of people who were in the survey. [1]

5 (a) Evaluate

$$(i) \quad 3 \begin{pmatrix} 2 \\ 4 \\ 0 \end{pmatrix} - 2 \begin{pmatrix} 1 \\ 6 \\ -3 \end{pmatrix}, \quad [2]$$

$$(ii) \quad (1 \ 3 \ 4) \begin{pmatrix} 0 & 4 \\ 3 & 1 \\ 5 & 0 \end{pmatrix}. \quad [2]$$

$$(b) \quad A = \begin{pmatrix} 2 & -3 \\ 0 & 1 \end{pmatrix}$$

(i) Find A^{-1} . [2]

(ii) The transformation represented by the matrix A maps (h,k) onto $(10,2)$.
Find the value of h and the value of k . [2]

6 (a) 100 g of spaghetti contains 3.6 g of fibre.

Express

mass of fibre : mass of spaghetti

as the ratio of two integers in its simplest form. [1]

(b) A tin contains 210 g of beans.

(i) 100 g of beans contains 4.5 g of protein.
Calculate the mass of protein in the tin. [1]

(ii) 100 g of beans contains 0.3 g of fat.
(a) What percentage of the beans is fat? [1]

(b) The recommended daily amount of fat is 70 g.
Calculate what percentage of the recommended daily amount is in the tin. [3]

(iii) The mass of salt in 100 g of beans is 1.0 g, correct to 1 decimal place.
Calculate an upper bound for the mass of salt contained in the tin. [2]

(c) A tin of soup contains 166 calories.
This is 8.3% of the recommended daily number of calories.
Calculate the recommended daily number of calories. [2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

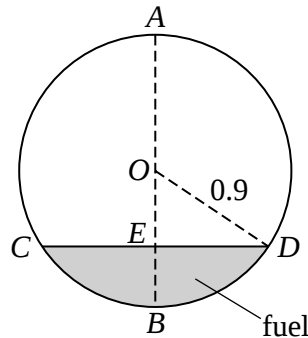
- 7 (a) A fuel tank is a cylinder of diameter 1.8 m.

- (i) The tank holds 25 000 litres when full.

Given that $1\text{m}^3 = 1000$ litres, calculate the length of the cylinder.
Give your answer in metres.

[4]

- (ii)



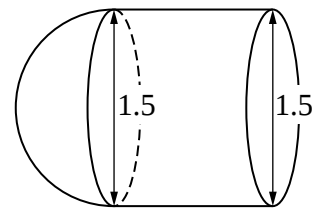
The diagram shows the cross-section of the cylinder, centre O , containing some fuel.
 CD is horizontal and is the level of the fuel in the cylinder.
 AB is a vertical diameter and intersects CD at E .

Given that E is the midpoint of OB ,

- (a) show that $\hat{EOD} = 60^\circ$, [1]
 (b) calculate the area of the segment BCD , [3]
 (c) calculate the number of litres of fuel in the cylinder. [2]

- (b) [Volume of a sphere = $\frac{4}{3}\pi r^3$]

A different fuel tank consists of a cylinder of diameter 1.5 m
and a hemisphere of diameter 1.5 m at one end.



The volume of the cylinder is 10 times the volume of the hemisphere.

Calculate the length of the cylinder.

[2]

8 Answer the whole of this question on a sheet of graph paper.

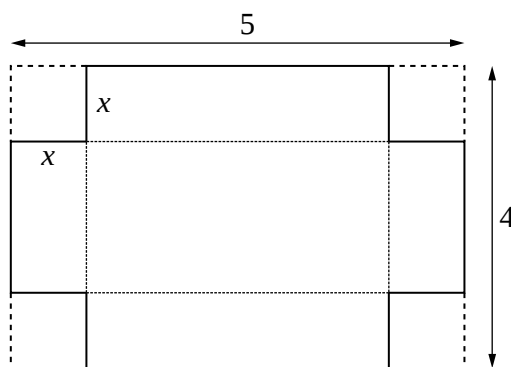
- (a)** The variables x and y are connected by the equation

$$y = 4x^3 - 18x^2 + 20x.$$

The table below shows some values of x and the corresponding values of y .

x	0	0.5	1	1.5	2	2.5	3	3.5
y	0	6	6	3	0	0	6	p

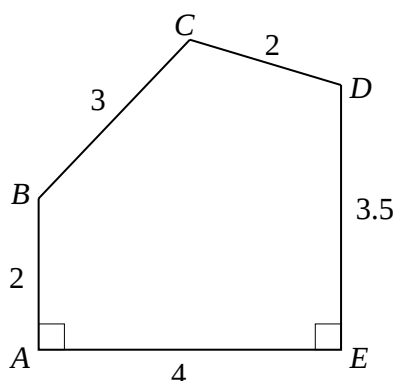
- (i)** Calculate the value of p . [1]
- (ii)** Using a scale of 2 cm to represent 1 unit, draw a horizontal x -axis for $0 \leq x \leq 4$.
Using a scale of 1 cm to represent 2 units, draw a vertical y -axis for $-4 \leq y \leq 24$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]
- (iii)** Using your graph, find the values of x when $y = 4$. [2]
- (b)** A rectangular card is 5 cm long and 4 cm wide.
As shown in the diagram, a square of side x centimetres is cut off from each corner.



The card is then folded to make an open box of height x centimetres.

- (i)** Write down expressions, in terms of x , for the length and width of the box. [1]
- (ii)** Show that the volume, V cubic centimetres, of the box is given by the equation
- $$V = 4x^3 - 18x^2 + 20x. \quad [2]$$
- (iii)** Which value of x found in **(a)(iii)** **cannot** be the height of a box with a volume of 4 cm^3 ? [1]
- (iv)** Using the graph drawn in part **(a)(ii)**, find
- (a)** the greatest possible volume of a box made from this card, [1]
- (b)** the height of the box with the greatest volume. [1]

- 9 (a) The diagram shows the side $ABCDE$ of a building.



$AB = 2$ m, $BC = 3$ m, $CD = 2$ m, $DE = 3.5$ m and $EA = 4$ m.

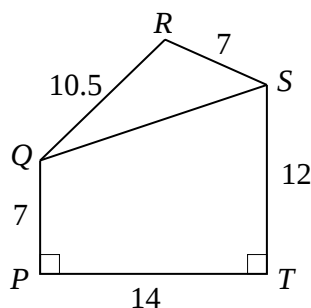
AB and DE are vertical.

AE is horizontal.

- (i) Using a scale of 2 cm to 1 m, construct an accurate scale drawing of $ABCDE$. [3]

- (ii) Measure and write down $\hat{ABC}$. [1]

- (b) The diagram shows the pentagon $PQRST$.



$PQ = 7$ cm, $QR = 10.5$ cm, $RS = 7$ cm, $ST = 12$ cm and $TP = 14$ cm.

$\hat{QPT} = \hat{PTS} = 90^\circ$.

- (i) Explain why the shapes $ABCDE$ and $PQRST$ are not geometrically similar. [1]
- (ii) Show that $QS^2 = 221$. [2]
- (iii) Calculate $\hat{QRS}$. [3]
- (iv) Calculate $\hat{RQS}$. [2]

10 Answer the whole of this question on a sheet of graph paper.

80 electric light bulbs of brand A were tested to find how long each bulb lasted.
The results are summarised in the table below.

Time (t hours)	$t \leq 50$	$50 < t \leq 100$	$100 < t \leq 150$	$150 < t \leq 200$	$200 < t \leq 250$	$250 < t \leq 300$	$300 < t \leq 350$	$350 < t \leq 400$
Number of bulbs	1	2	6	34	26	8	2	1

(a) Copy and complete the following cumulative frequency table.

Time (t hours)	$t \leq 50$	$t \leq 100$	$t \leq 150$	$t \leq 200$	$t \leq 250$	$t \leq 300$	$t \leq 350$	$t \leq 400$
Number of bulbs	1	3						80

[1]

(b) Using a horizontal scale of 2 cm to represent 50 hours and a vertical scale of 2 cm to represent 10 bulbs, draw a smooth cumulative frequency curve for these brand A bulbs. [3]

(c) Use your graph to estimate

(i) the median, [1]

(ii) the 10th percentile. [1]

(d) 80 brand B bulbs were also tested and a report on the test gave the following information.

3 bulbs lasted 50 hours or less.
No bulbs lasted more than 350 hours.
The median time was 250 hours.
The upper quartile was 275 hours.
The interquartile range was 75 hours.

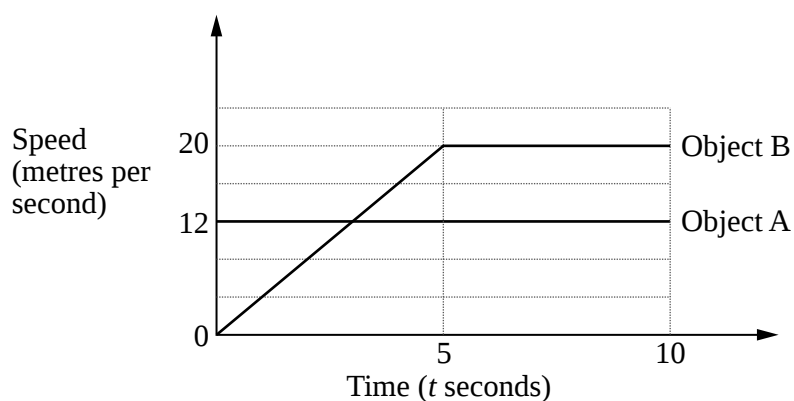
On the same axes, draw a smooth cumulative frequency curve for the brand B bulbs. [3]

(e) Use your graphs to estimate the number of bulbs that lasted 260 hours or less

(i) for brand A, [1]

(ii) for brand B. [1]

(f) Which brand of bulb is more likely to last longer than 250 hours?
Justify your answer. [1]



The diagram shows the speed-time graphs of two objects, A and B, for the first 10 seconds of their motion.

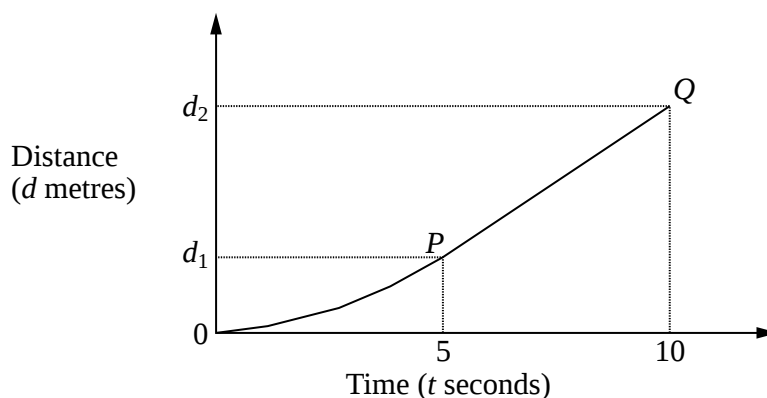
Object A travelled at a constant speed of 12 m/s throughout the 10 seconds.

Object B started from rest, and accelerated at a constant rate, attaining a speed of 20 m/s after 5 seconds. It then travelled at a constant speed of 20 m/s.

(a) Calculate

- (i) the distance travelled by object B during the first 5 seconds of its motion, [1]
- (ii) the average speed of object B for the first 10 seconds of its motion, [2]
- (iii) the value of t when both objects were travelling at the same speed, [2]
- (iv) the value of t when both objects had travelled the same distance. [2]

(b) The diagram below shows the distance-time graph for object B.



In the diagram, OP is a curve and PQ is a straight line.

- (i) State the values of d_1 and d_2 . [1]
 - (ii) What does the gradient of the straight line PQ represent? [1]
 - (iii) Write down the gradient of the tangent to the curve at $t = 2.5$. [1]
- (c) After 10 seconds, both objects slowed down at the same constant rate. Object A came to rest after a further 9 seconds. After how many seconds **from the start of its motion** did object B come to rest? [2]

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

October/November 2010

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
Electronic calculator
Geometrical instruments

Graph paper (1 sheet)
Mathematical tables (optional)



READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

Show all your working on the same page as the rest of the answer.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions. You may use mathematical tables as well if necessary.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **10** printed pages and **2** blank pages.



Section A [52 marks]Answer **all** questions in this section.

1 (a) $P = \frac{7Q}{4} + 15$

(i) Find P when $Q = -40$. [1](ii) Express Q in terms of P . [2]

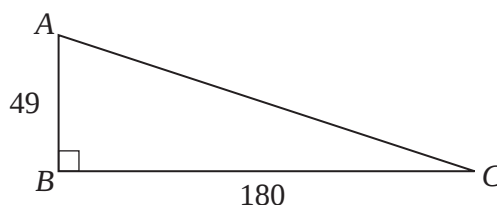
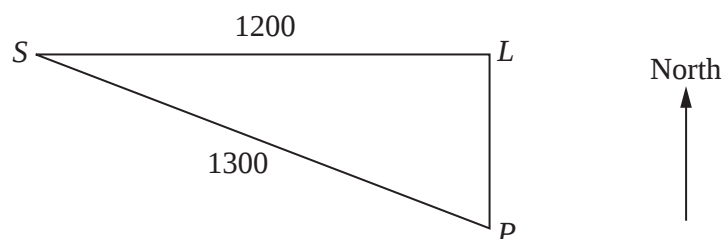
(b) Factorise completely

(i) $7c^2 - 28d^2$, [2]

(ii) $3x^2 - 7x - 6$. [2]

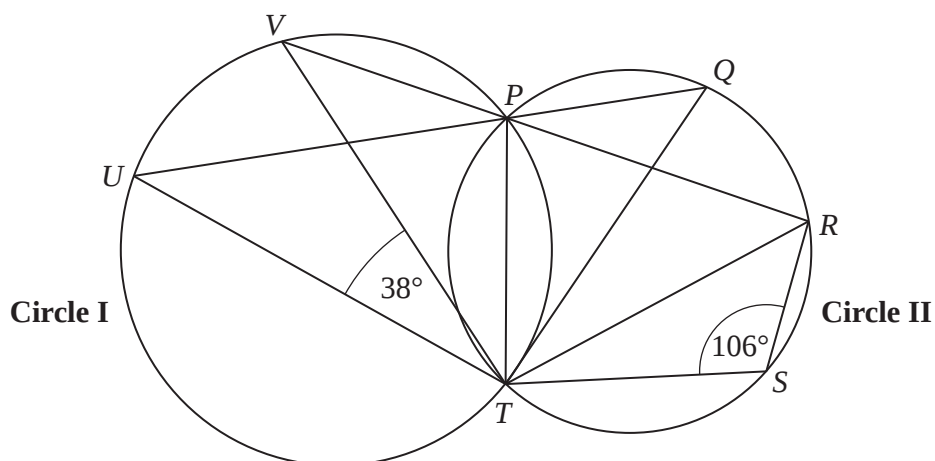
(c) Solve the equation $\frac{4}{7-y} = 5$. [2]

2 (a)

 AB is vertical and BC is horizontal. $AB = 49\text{ m}$ and $BC = 180\text{ m}$.(i) Calculate $\hat{BAC}$. [2](ii) State the value of the angle of depression of C from A . [1](b) S and P are two positions at sea and L is a Lighthouse. S is due West of L and P is due South of L . $SL = 1200\text{ m}$ and $SP = 1300\text{ m}$.(i) Calculate LP . [2](ii) Calculate the bearing of S from P . [3](iii) A boat sailed from S to P .
It left S at 15 56 and reached P at 16 04.

Calculate its speed in kilometres per hour. [2]

3 (a)

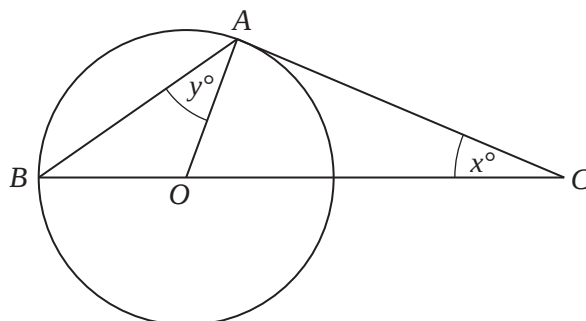


The points P , T , U and V lie on **Circle I**, and the points P , Q , R , S and T lie on **Circle II**.
 UPQ and VPR are straight lines.
 $\widehat{VTU} = 38^\circ$ and $\widehat{TSR} = 106^\circ$.

Find

- | | |
|-------------------------|-----|
| (i) $\widehat{VPU}$, | [1] |
| (ii) $\widehat{QTR}$, | [1] |
| (iii) $\widehat{TPR}$, | [1] |
| (iv) $\widehat{UPT}$. | [1] |

(b)



A and B are points on the circle, centre O .
 CA is a tangent at A and BOC is a straight line.
 $\widehat{ACB} = x^\circ$ and $\widehat{BAO} = y^\circ$.

Find an expression for y in terms of x .

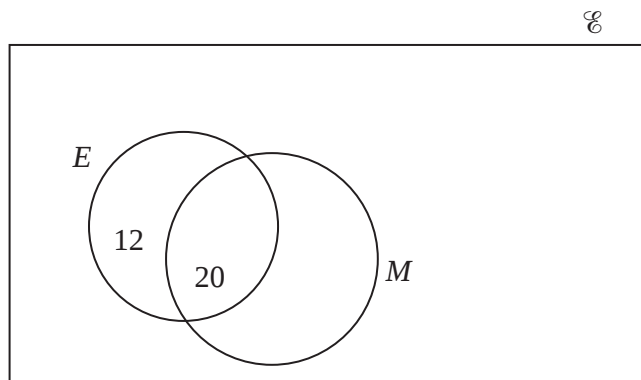
[3]

- 4 (a) $\mathcal{E} = \{x : x \text{ is an integer and } 10 \leq x \leq 21\}$

$$E = \{x : x \text{ is an even number}\}$$

$$M = \{x : x \text{ is a multiple of 5}\}$$

$$P = \{x : x \text{ is a prime number}\}$$



The Venn diagram shows the Universal set $\mathcal{E}$ and the subsets E and M .
Two elements of $\mathcal{E}$ are shown in their appropriate subsets.

- (i) Copy the Venn diagram shown above and draw the subset P . [1]
- (ii) Write the remaining 10 elements of $\mathcal{E}$ in the appropriate subsets of your Venn diagram. [3]
- (b) $\mathcal{E} = \{\text{letters of the alphabet}\}$
- $J = \{a, b, c, d, e, f, g\}$
- $K = \{a, e, i, o, u\}$
- (i) Find $n(J \cup K)$. [1]
- (ii) Find $J \cap K'$. [1]
- (iii) Given that $L \subset J$ and $L \subset K$, state the maximum value of $n(L)$. [1]
- (iv) A letter is picked at random from K .
Find the probability that it is **not** an element of J . [1]
- (c) In a school, 24 students are members of the Athletics Club, 30 students are members of the Basketball Club and 36 students are members of the Drama Club.
5 students are members of all three clubs.
12 students are members of both the Athletics Club and the Drama Club.
13 students are members of both the Basketball Club and the Athletics Club.
19 students are members of both the Drama Club and the Basketball Club.
- (i) How many students are members of the Basketball Club, but are not members of the other two Clubs? [1]
- (ii) How many students are members of one or more of the Clubs? [1]

- 5 Archie bought a car from a dealer.
The dealer sold the car for \$7040.
Archie paid a deposit of \$1760.

(a) Calculate the deposit as a percentage of the dealer's selling price. [1]

- (b) Archie took out a loan agreement to repay the outstanding balance of \$5280.
He paid \$212.67 per month for 36 months.

Calculate

(i) the amount of interest that he paid, [2]

(ii) the rate of simple interest per year that had been charged. [3]

- (c) When the dealer sold the car, he made a profit of 30%.

Calculate the profit, correct to the nearest dollar, that the dealer made on the sale of this car. [3]

- 6 (a) The results of a survey of the number of televisions in 40 households are given in the table below.

Number of televisions	1	2	3	4
Number of households	8	17	12	3

(i) Calculate the mean number of televisions per household. [2]

- (ii) The survey was extended to include 5 more households.
It was found that none of these had a television.

For the 45 households, calculate the mean number of televisions per household. [1]

- (b) 120 children were asked which colour they liked best.
59 said red, 21 said blue and the rest said yellow.

(i) Using a radius of 4 cm, draw an accurate pie chart to show these results. [3]

- (ii) Out of the children who liked blue best, $\frac{5}{7}$ were wearing blue socks.

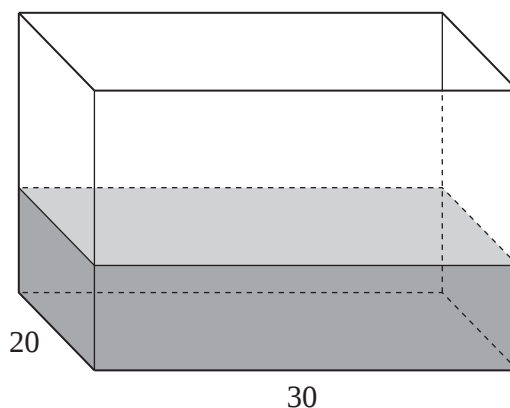
How many of the children who liked blue best were not wearing blue socks? [1]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

7



The diagram shows an open rectangular tank with base 20 cm by 30 cm.
The tank contains 9600 cm^3 of water.

- (a) (i) State the number of litres of water in the tank. [1]
- (ii) Calculate the depth of the water. [2]
- (iii) Calculate the **total** surface area of the tank that is in contact with the water. [2]
- (iv) The water had entered the tank through a circular pipe of radius 0.8 cm.
It flowed through the pipe at 25 centimetres per second.
- How long did the 9600 cm^3 of water take to enter the tank?
Give your answer correct to the nearest second. [3]
- (b) [Volume of a sphere = $\frac{4}{3} \pi r^3$]
- 250 identical spheres are placed in the bottom of the tank.
Each sphere has a volume of 2.6 cm^3 .
- (i) Calculate by how much the water level in the tank will rise.
Give your answer in millimetres. [2]
- (ii) Calculate the radius of one of these spheres. [2]

8 Answer the WHOLE of this question on a sheet of graph paper.

The variables x and y are connected by the equation

$$y = x^2 - 1.$$

- (a)** Copy and complete the following table of values. [2]

x	-4	-3	-2	-1	0	1	2	3	4
y									

- (b)** Using a scale of 2 cm to represent 1 unit, draw a horizontal x -axis for $-4 \leq x \leq 4$.
Using a scale of 1 cm to represent 1 unit, draw a vertical y -axis for $-2 \leq y \leq 16$.

On your axes, plot the points from your table and join them with a smooth curve. [3]

- (c)** It is given that $f(x) = \frac{x+7}{2}$.

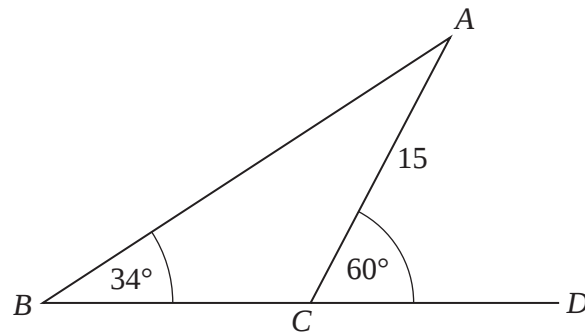
(i) Using the same axes, draw the graph of $y = f(x)$. [2]

(ii) Find $f^{-1}(3)$. [2]

(iii) (a) Write down the x coordinates of the two points where the graphs intersect. [1]

(b) Find the equation that is satisfied by these two values of x .
Express your answer in the form $ax^2 + bx + c = 0$, where a , b and c are integers. [2]

9 (a)

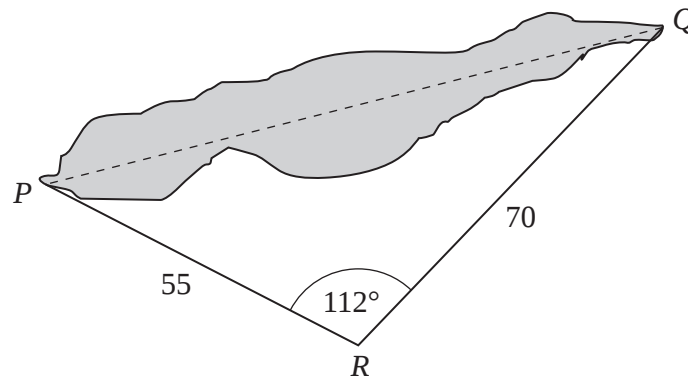


ABC is a triangle in which $\hat{ABC} = 34^\circ$ and $AC = 15$ cm.
 BCD is a straight line and $\hat{ACD} = 60^\circ$.

Find

- (i) $\hat{BAC}$, [1]
 (ii) BC . [2]

(b)

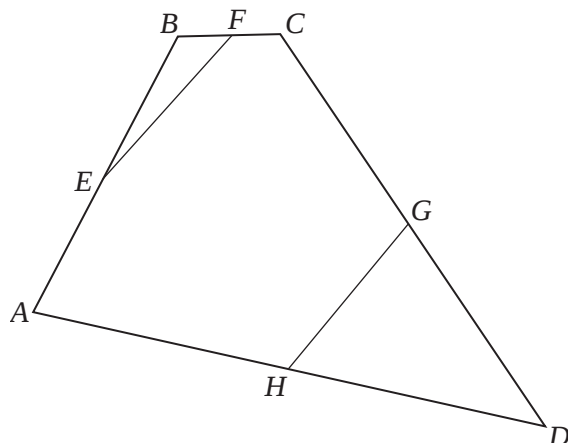


The shaded part of the diagram shows a lake. P and Q are points at each end of the lake.
 R is a point on the same level ground as P and Q .

$PR = 55$ m, $QR = 70$ m and $\hat{PRQ} = 112^\circ$.

- (i) Calculate PQ . [4]
 (ii) A plan is drawn using a scale of 1 centimetre to 5 metres.
 (a) State the lengths of PR and QR on the plan. [1]
 (b) Find the area of triangle PQR on the plan. [2]
 (c) The area of the lake on the plan is 32.4 cm^2 .
 Calculate the actual area, in square metres, of the lake. [2]

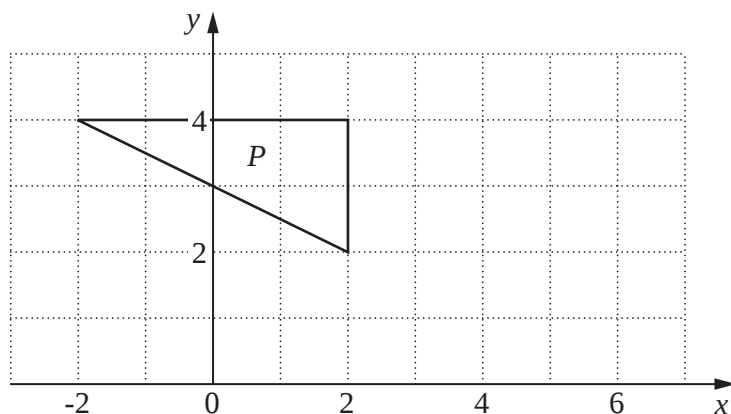
10 (a)



In the diagram, $ABCD$ is a quadrilateral where $\overrightarrow{AB} = \begin{pmatrix} 4 \\ 8 \end{pmatrix}$, $\overrightarrow{BC} = \begin{pmatrix} 2 \\ 0 \end{pmatrix}$ and $\overrightarrow{CD} = \begin{pmatrix} 8 \\ -12 \end{pmatrix}$.
 E , F , G and H are the midpoints of AB , BC , CD and DA respectively.

- (i) Find $\overrightarrow{AD}$. [1]
- (ii) Calculate $|\overrightarrow{AD}|$. [2]
- (iii) Show that EF and HG are opposite sides of a parallelogram. [2]

(b) The diagram shows triangle P .



Triangle Q has vertices $(-2, 4)$, $(6, 0)$ and $(6, 4)$.

Describe **fully** the **single** transformation that maps triangle P onto triangle Q . [3]

- (c) The transformation represented by the matrix $\begin{pmatrix} 5 & 2 \\ 0 & 3 \end{pmatrix}$ maps the square $O(0, 0)$, $U(1, 0)$, $V(1, 1)$, $W(0, 1)$ onto $OU'V'W'$.
 - (i) Find the coordinates of U' , V' and W' . [2]
 - (ii) Find the matrix that represents the transformation that maps $OU'V'W'$ onto $OUVW$. [2]

11 A gardener uses *No-Weed* to kill weeds in his lawn.

- (a)** He mixes 15 ml of *No-Weed* with 5 litres of water.

Calculate the ratio of *No-Weed* to water in the mixture.

Express the ratio in the form $m : n$, where m and n are the smallest possible whole numbers. [1]

- (b)** The gardener's lawn is a rectangle of length 27 metres and width 25 metres.

- (i)** 15 ml of *No-Weed* are required to kill weeds in 10 m^2 of lawn.
No-Weed is sold in 500 ml bottles.

(a) How many bottles does the gardener need to buy? [3]

(b) How many millilitres are not used? [1]

- (ii)** The lawn is to be made larger.

The length is increased by $3x$ metres and the width by x metres.

The area of the larger lawn is twice that of the original lawn.

(a) Form an equation in x and show that it reduces to $x^2 + 34x - 225 = 0$. [2]

(b) Solve the equation $x^2 + 34x - 225 = 0$, giving each answer correct to 2 decimal places. [4]

(c) Hence find the length of the larger lawn. [1]

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

October/November 2010

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
Electronic calculator
Geometrical instruments

Graph paper (1 sheet)
Mathematical tables (optional)



READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

Show all your working on the same page as the rest of the answer.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions. You may use mathematical tables as well if necessary.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **11** printed pages and **1** blank page.



Section A [52 marks]

Answer **all** questions in this section.

1 (a) Simplify

(i) $\frac{x+y}{8x+8y}$, [1]

(ii) $x(3x-2) - (3x^2-5)$. [2]

(b) Solve the equation $3t-4 = 7+2(t+3)$. [2]

(c) Factorise $5px-7qx+10py-14qy$. [2]

(d) (i) When $x = -2$, which of the two expressions, $3x+4$ and $2-x$, has the greater value?
You must show your working. [2]

(ii) Solve the inequality $3x+4 < 2-x$. [2]

2 (a) The rate of exchange between pounds (£) and dollars (\$) is £1 = \$1.87.
The rate of exchange between pounds (£) and euros (€) is £1 = € 1.21.

(i) Catherine changes £500 into dollars.

Calculate how many dollars she receives. [1]

(ii) Esther changes € 726 into pounds.

Calculate how many pounds she receives. [1]

(iii) Rose changes \$850 into euros.

Calculate how many euros she receives. [2]

(b) Matthew changes \$770 into rupees.
He receives 40 000 rupees.

How many rupees did he receive for each dollar? [2]

(c) (i) Lily bought a car for \$13 500.
She paid for it in 36 equal monthly payments.

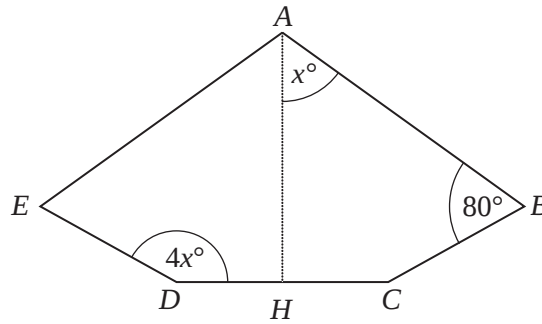
Calculate the amount she paid each month. [1]

(ii) George bought a car for \$27 000.
He borrowed the \$27 000 at 15% per year simple interest for 3 years.
He repaid the **total** amount in 36 equal monthly payments.

Calculate the amount he paid each month. [3]

- 3 (a) Calculate the interior angle of a regular 10-sided polygon. [2]

(b)

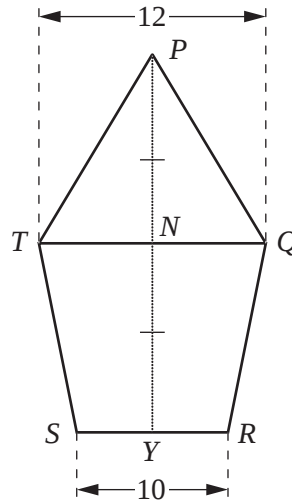


AH is the line of symmetry of the pentagon $ABCDE$.
 $\hat{HAB} = x^\circ$, $\hat{ABC} = 80^\circ$ and $\hat{EDH} = 4x^\circ$.

Find x .

[3]

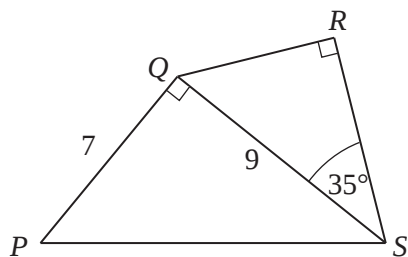
(c)



PY is the line of symmetry of the pentagon $PQRST$.
 PY and TQ intersect at N .
 $PN = NY$.
 $TQ = 12\text{ cm}$ and $SR = 10\text{ cm}$.

- (i) Given that $PY = 2h$ centimetres, find an expression, in terms of h , for the area of the trapezium $QRST$. [2]
- (ii) Given that the area of $PQRST$ is 221 cm^2 , calculate h . [2]

4 (a)



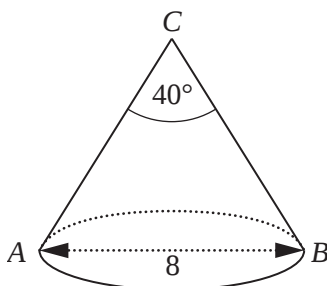
In the quadrilateral $PQRS$, $PQ = 7$ cm and $QS = 9$ cm.
 $\angle QPS = \angle QRS = 90^\circ$ and $\angle QSR = 35^\circ$.

Calculate

(i) $\angle SPQ$, [2]

(ii) RS . [2]

(b) [The area of the curved surface of a cone of radius r and slant height l is πrl]



The diagram shows a cone ABC .
 The diameter $AB = 8$ cm and $\angle ACB = 40^\circ$.

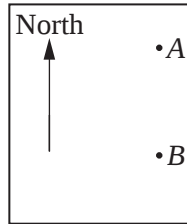
Calculate the curved surface area of this cone. [3]

5 The table shows the distribution of the masses of 90 apples.

Mass (m grams)	$60 < m \leq 80$	$80 < m \leq 90$	$90 < m \leq 95$	$95 < m \leq 100$	$100 < m \leq 110$	$110 < m \leq 130$
Frequency	10	16	20	21	22	1

- (a) In which interval does the median lie? [1]
- (b) Calculate an estimate of the mean. [3]
- (c) A histogram is drawn to represent this information.
- (i) Calculate the frequency density of the interval $90 < m \leq 95$. [1]
- (ii) The rectangle representing the apples with masses in the interval $80 < m \leq 90$ has width 2 cm and height 4 cm.
- Find the width and height of the rectangle representing the apples with masses in the interval $90 < m \leq 95$. [2]
-

6 Answer this question on a new page.



A and B are two coastguard stations with A due north of B .

On your new blank page, mark A in a position near the top right hand corner, as shown in the diagram.

- (a) The distance between A and B is 140 km.

Using a scale of 1 cm to 10 km,

- (i) mark the position of B and draw the line AB , [1]

- (ii) construct the locus of the points west of AB that are

- (a) equidistant from A and B , [1]

- (b) 90 km from B . [1]

- (b) A ship, S , lies to the west of AB and is

I nearer to A than B ,

II within 90 km of B .

On your diagram, shade the region in which the ship is situated. [1]

- (c) It is also known that the bearing of the ship from A is 204° .

- (i) On your diagram, mark the two extreme positions, S_1 and S_2 , of the ship. [2]

- (ii) Measure the angle S_1BS_2 . [1]

- (iii) The bearing of the ship from B is x° .

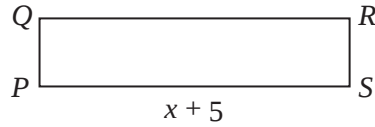
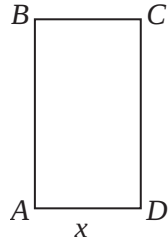
Find the least possible value of x . [1]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

7



$ABCD$ and $PQRS$ are rectangles.

Each rectangle has an area of 13 cm^2 .

$AD = x$ centimetres and $PS = (x + 5)$ centimetres.

(a) Find, in terms of x , an expression for

(i) AB , [1]

(ii) PQ . [1]

(b) Given that AB is 3 cm greater than PQ , form an equation in x and show that it simplifies to

$$3x^2 + 15x - 65 = 0. \quad [3]$$

(c) Solve the equation $3x^2 + 15x - 65 = 0$, giving each answer correct to 2 decimal places. [4]

(d) (i) Show that the perimeter of $ABCD$ is 14.9 cm, correct to 3 significant figures. [1]

(ii) Find the difference between the perimeters of the two rectangles. [2]

8 Answer the whole of this question on a sheet of graph paper.

The variables x and y are connected by the equation

$$y = \frac{x^3}{10} - \frac{x}{2}.$$

The table below shows some corresponding values of x and y .

x	0	1	2	3	4	4.5
y	0	-0.4	-0.2	1.2	4.4	p

(a) Calculate p . [1]

(b) Using a scale of 2 cm to 1 unit on each axis, draw a horizontal x -axis for $0 \leq x \leq 5$ and a vertical y -axis for $-1 \leq y \leq 7$.

On your axes, plot the points given in the table and join them with a smooth curve. [3]

(c) Use your graph to solve the equation $\frac{x^3}{10} - \frac{x}{2} = 0.3$ for values of x in the range $0 \leq x \leq 5$. [1]

(d) (i) Draw the chord joining the two points (0, 0) and (3, 1.2) and calculate its gradient. [1]

(ii) Draw a tangent at the point where the gradient of the curve is equal to the gradient of the chord. [1]

(e) (i) On the same axes, draw the graph of the straight line $y = -x + 6$. [2]

(ii) Write down the x coordinate of the point where the line crosses the curve. [1]

(iii) This value of x is a solution of the equation $x^3 + Ax + B = 0$.

Find A and B . [2]

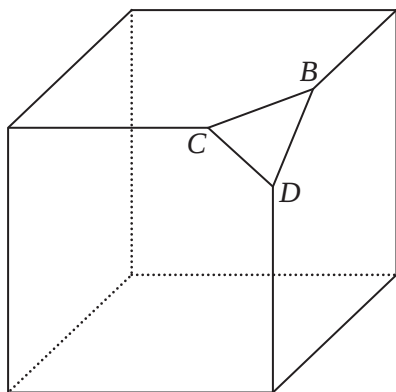


Diagram I

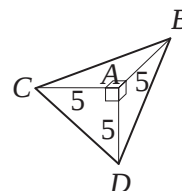


Diagram II

Diagram I shows a cube with a triangular pyramid removed from one vertex. This triangular pyramid $ABCD$ is shown in Diagram II.
 $AB = AC = AD = 5$ cm.

- (a) State the height of this pyramid when the base is triangle ABD . [1]
- (b) [The volume of a pyramid = $\frac{1}{3} \times \text{area of base} \times \text{height}$]
 Calculate
- (i) the volume of the pyramid, [2]
- (ii) the area of triangle BCD , [3]
- (iii) the height of the pyramid when the base is triangle BCD . [3]
- (c) An identical triangular pyramid is removed from each of the other 7 vertices of the cube to form the new solid shown in Diagram III.

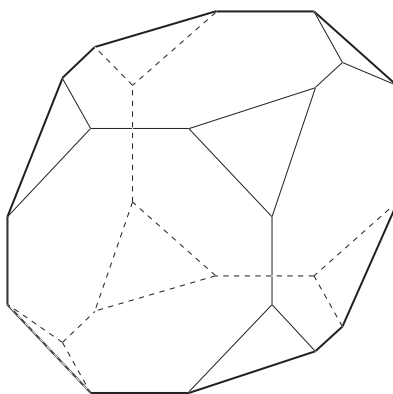


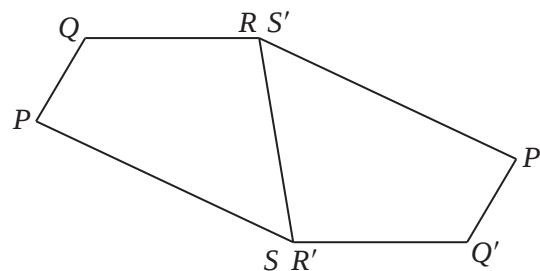
Diagram III

The original cube had 6 faces, 8 vertices and 12 edges.
 For the new solid, write down the number of

- (i) faces, [1]
- (ii) vertices, [1]
- (iii) edges. [1]

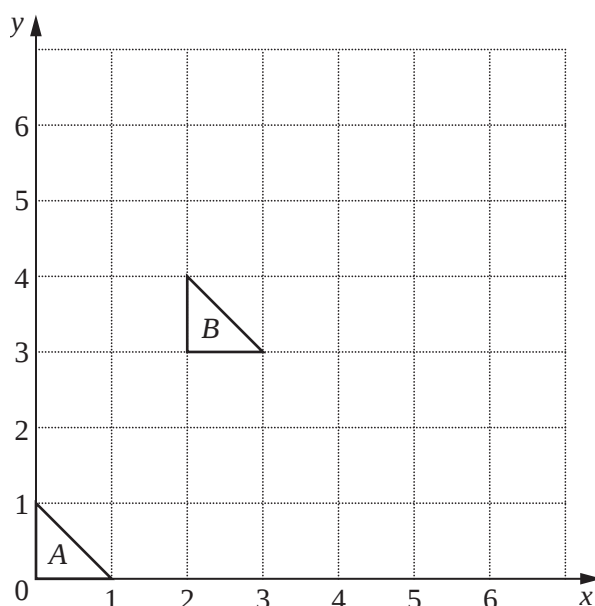
- 10 (a) $PQRS$ and $P'Q'R'S'$ are congruent quadrilaterals.
 R is the same point as S' .
 S is the same point as R' .

A single transformation maps P onto P' ,
 Q onto Q' , R onto R' and S onto S' .



- (i) Describe fully this transformation. [3]
(ii) Write down two facts connecting PQ and $Q'P'$. [1]

(b)



The diagram shows triangle A and triangle B .

- (i) A translation, T , maps triangle A onto triangle B .

State the column vector representing this translation. [1]

- (ii) The transformation, S , that maps triangle A onto triangle C is represented by the matrix $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$.

Find the vertices of triangle C . [2]

- (iii) Given that $TS(A) = D$, find the vertices of triangle D . [1]

- (iv) Triangle E has vertices $(0,0)$, $(2,0)$ and $(0,3)$.

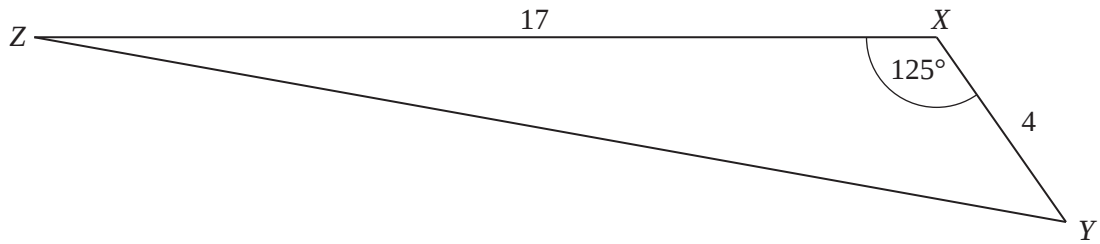
- (a) It is given that $(0,0) \rightarrow (0,0)$, $(1,0) \rightarrow (2,0)$ and $(0,1) \rightarrow (0,3)$.

Find the matrix that represents this transformation. [2]

- (b) Describe fully the **single** transformation that maps triangle A onto triangle E . [2]

11

11

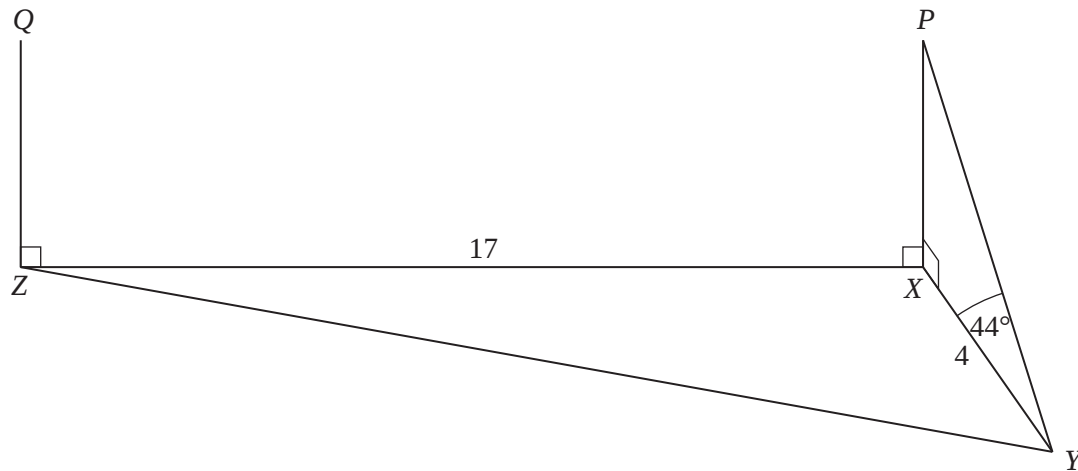


The points X , Y and Z are on horizontal ground.
 $XY = 4$ km, $XZ = 17$ km and $\hat{YXZ} = 125^\circ$.

(a) Calculate YZ .

[4]

(b)



The points P and Q are the same height vertically above X and Z respectively.

(i) When an aircraft was at P , its angle of elevation from Y was 44° .

Calculate PX .

Give your answer in metres, correct to the nearest 100 metres.

[3]

(ii) The aircraft took 2 minutes 54 seconds to fly from P to Q .

(a) The aircraft reached its destination 39 minutes 6 seconds after flying over Q .
 The flight ended at 15 03.

At what time did the aircraft fly over P ?

[2]

(b) Calculate the average speed of the aircraft as it flew from P to Q .
 Give your answer in kilometres per hour.

[3]

12
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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

October/November 2011

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

For Examiner's Use

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This document consists of **20** printed pages.



Section A [52 marks]

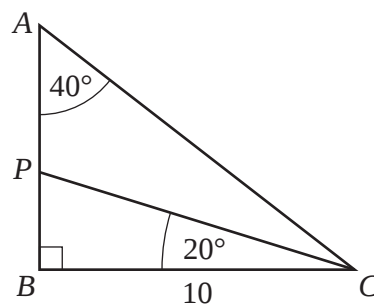
Answer **all** the questions in this section.

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1

ABC is a triangle in which $\hat{ABC} = 90^\circ$, $\hat{BAC} = 40^\circ$ and $BC = 10$ cm.

P is the point on AB such that $\hat{PCB} = 20^\circ$.



Calculate

(a) PB ,

Answer cm [2]

(b) AP ,

Answer cm [2]

(c) the perimeter of triangle PBC .

Answer cm [3]

- 2 (a) Solve $5t(3t + 7) = 0$.

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margin

Answer $t = \dots\dots\dots$ or $\dots\dots\dots$ [2]

- (b) Solve the simultaneous equations.

$$\begin{aligned} 3x + 4y &= 1 \\ 5x - 8y &= 9 \end{aligned}$$

Answer $x = \dots\dots\dots$

$y = \dots\dots\dots$ [3]

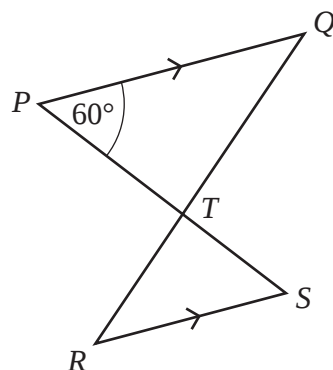
- (c) Express as a single fraction $\frac{5}{p-2} - \frac{4}{2p+3}$.

Answer $\dots\dots\dots$ [3]

- (d) Simplify $\frac{q^2 - 1}{2q^2 - 3q + 1}$.

Answer $\dots\dots\dots$ [3]

- 3 P, Q, R and S are four points on level ground.
 PQ is parallel to RS and $\angle QPS = 60^\circ$.
 PS and RQ intersect at T .



North

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- (a) Write down the value of $\angle PSR$. Give a reason for your answer.

Answer $\angle PSR = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [1]

- (b) The bearing of Q from P is 070° .
 Find the bearing of

- (i) S from P ,

Answer $\dots\dots\dots$ [1]

- (ii) P from S ,

Answer $\dots\dots\dots$ [1]

- (iii) R from S .

Answer $\dots\dots\dots$ [1]

- (c) (i) Explain why triangles PQT and SRT are similar.

Answer $\dots\dots\dots$
 $\dots\dots\dots$ [1]

- (ii) Given that $PT = 54\text{ m}$, $TS = 36\text{ m}$ and $RQ = 85\text{ m}$, find TQ .

Answer $\dots\dots\dots$ m [3]

- 4 A fair five-sided spinner is numbered 1, 3, 5, 7 and 9.

(a) Maria spins it once. Find the probability that the number obtained is

(i) 7,

Answer [1]

(ii) an odd number.

Answer [1]

- (b) Pedro spins it twice and adds the two numbers obtained.
Some of the results are shown in the possibility diagram below.

+	1	3	5	7	9
1	2	4			
3					12
5					
7				14	
9					

(i) Complete the possibility diagram. [2]

(ii) Find the probability that the sum of the two numbers is

(a) odd,

Answer [1]

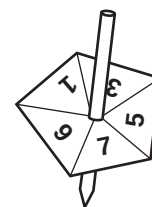
(b) 14 or more.

Answer [1]

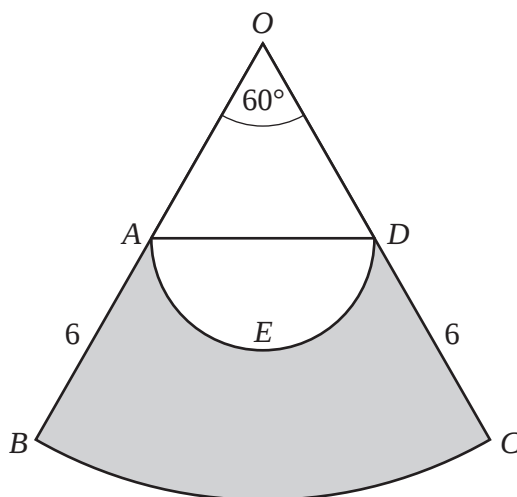
- (c) Katrina spins it three times.

Calculate the probability that the three numbers obtained are the same.
Express your answer as a fraction in its lowest terms.

Answer [2]



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In the diagram, OBC is the sector of a circle, centre O , and $\angle BOC = 60^\circ$.
 A and D are the midpoints of OB and OC respectively, and $AB = DC = 6$ cm.
 AED is a semicircle with AD as diameter.

(a) Show that $AD = 6$ cm.

[1]

(b) The length of the arc BC is $n\pi$ centimetres.

(i) Find n .

Answer [1]

(ii) Find $\frac{\text{the length of the arc } AED}{\text{the length of the arc } BC}$.

Answer [2]

- (c) (i) Find the area of the sector BOC .

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Answer cm^2 [2]

- (ii) Hence find the area of the shaded region.

Answer cm^2 [3]

- 6 (a) Ada and Bill own a company.

In 2008 Ada invests \$22 500 in the company and Bill invests \$37 500.

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- (i) Express $22\,500 : 37\,500$ in the form $m : n$, where m and n are the smallest possible integers.

Answer : [1]

- (ii) The profit made by the company in 2008 is shared in the ratio of the amounts invested.

Given that Ada's share of the profit is \$3 600, calculate the total profit made by the company.

Answer \$..... [1]

- (iii) Ada's investment in 2008 is $12\frac{1}{2}\%$ more than the amount she invested in 2007.

Calculate the amount that Ada invested in 2007.

Answer \$..... [2]

(b)

LAWNMOWER	Plan A: Deposit \$595 and 12 monthly payments of \$171.04
\$2395	Plan B: Deposit \$395 and 24 monthly payments of \$
	

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- (i) Rashid buys one of these lawnmowers for \$2395.
Sayeed buys one of these lawnmowers using Plan A.

In total, how much **more** than Rashid will Sayeed pay?

Answer \$..... [1]

- (ii) When one of these lawnmowers is bought using Plan B, the total cost is \$3054.20.

Calculate the monthly payment.

Answer \$..... [2]

- (iii) In a sale, the price of the lawnmower is reduced from \$2395 to \$1595.

Calculate the percentage discount.

Answer % [2]

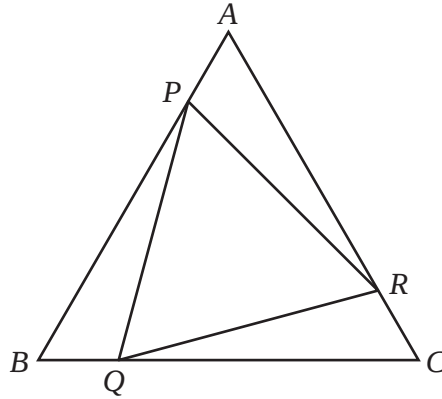
Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

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7 (a)



In the diagram, ABC is an equilateral triangle.

The points P , Q and R lie on AB , BC and CA respectively, such that $AP = BQ = CR$.

(i) Show that triangles APR , BQP and CRQ are congruent.

[3]

(ii) It is given that $AB = 5$ cm and $PQ = 4$ cm .

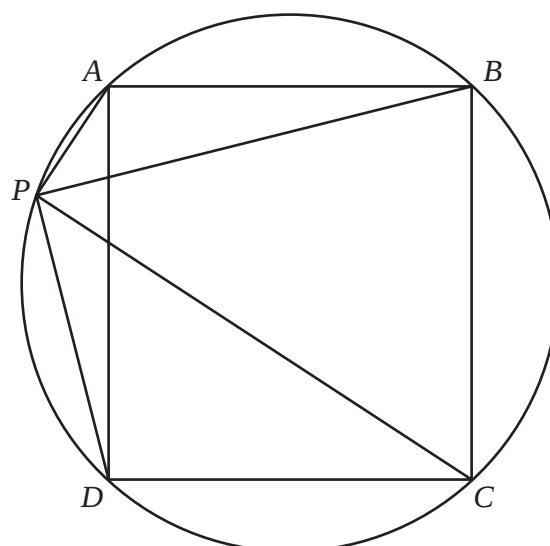
(a) Find $\frac{\text{Area of triangle } PQR}{\text{Area of triangle } ABC}$.

Answer[1]

(b) Find $\frac{\text{Area of triangle } APR}{\text{Area of triangle } ABC}$.

Answer[1]

- (b) In the diagram, $ABCD$ is a square.
The point P lies on the circle through A, B, C and D .



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- (i) Explain why $\hat{APC} = 90^\circ$.

Answer [1]

- (ii) Explain why $\hat{APB} = \hat{BPC}$.

Answer [2]

- (iii) Hence find

- (a) $\hat{APB}$,

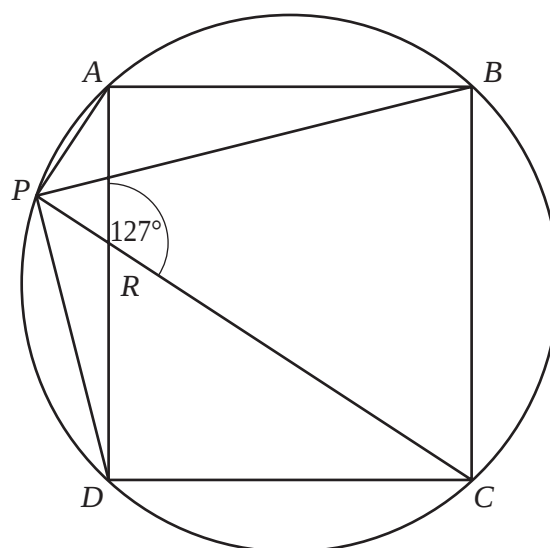
Answer [1]

- (b) $\hat{APD}$.

Answer [1]

- (iv) PC and AD intersect at R .

Given that $\hat{ARC} = 127^\circ$, find $\hat{PDC}$.



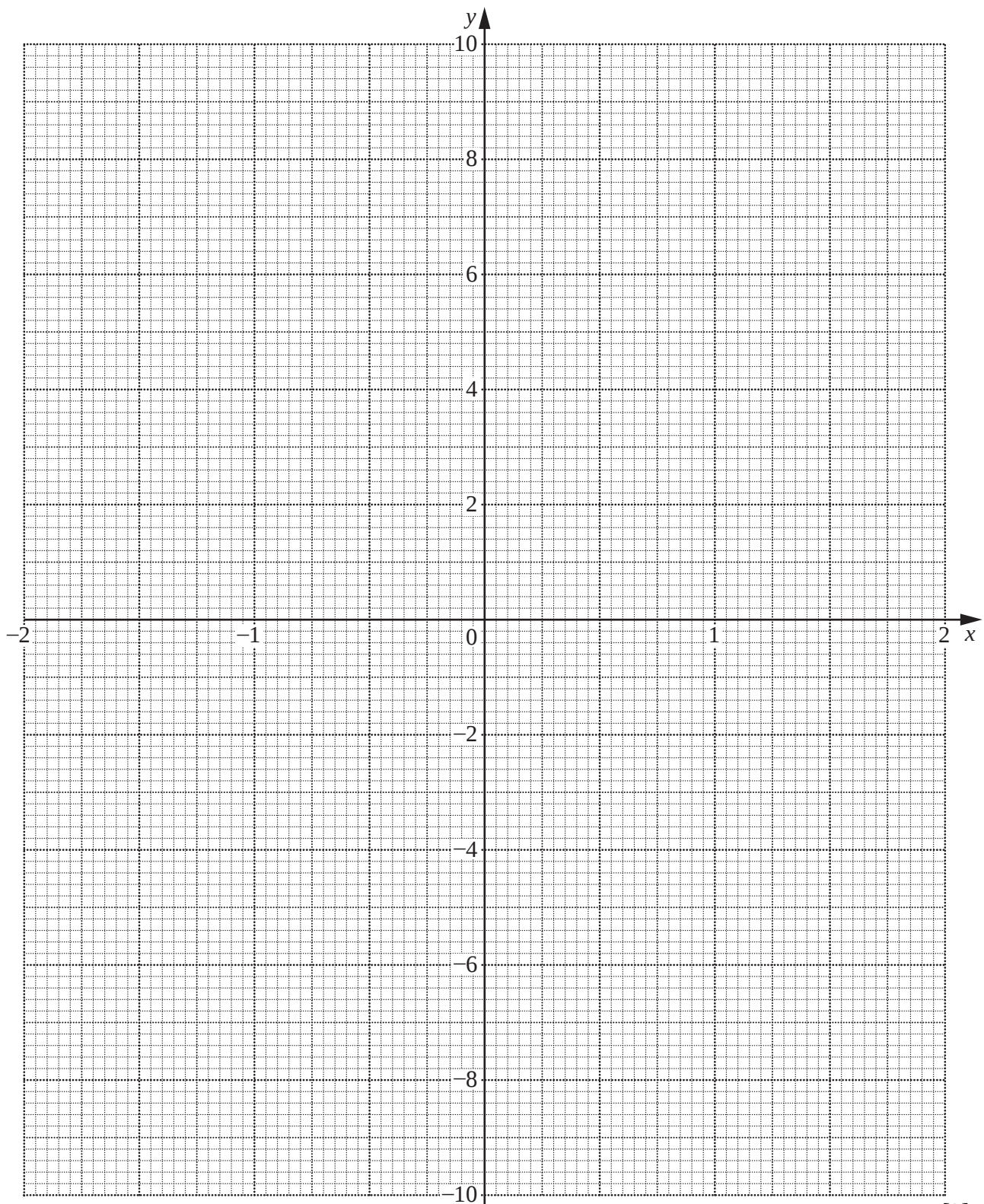
Answer [2]

- 8 The variables x and y are connected by the equation $y = 2x - \frac{5}{2x}$.

The table below shows some values of x and the corresponding values of y .
The values of y are correct to 1 decimal place where appropriate.

x	0.25	0.5	0.75	1	1.25	1.5	1.75	2
y	-9.5	-4	-1.8	-0.5	0.5	1.3	2.1	2.8

- (a) On the grid, plot the points given in the table and join them with a smooth curve.



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[2]

- (b) By drawing a tangent, find the gradient of the curve at the point $(0.75, -1.8)$.

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Answer [2]

- (c) The line $y = 2 - x$ intersects the curve $y = 2x - \frac{5}{2x}$ at the point P .

- (i) On the grid, draw the graph of the straight line $y = 2 - x$.

[2]

- (ii) Write down the x coordinate of P .

Answer [1]

- (iii) This value of x is a solution of the equation $6x^2 - Bx - C = 0$.

Find B and C .

Answer $B =$

$C =$ [3]

- (d) Let $f(x) = 2x - \frac{5}{2x}$.

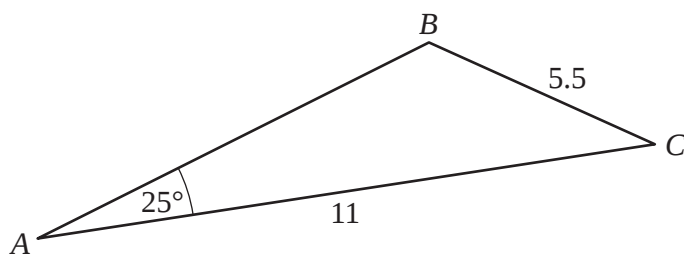
- (i) Given that $f(a) = b$, show that $f(-a) = -b$.

[1]

- (ii) **Hence**, using the table on the previous page, draw the graph of $y = 2x - \frac{5}{2x}$ for $-2 \leq x \leq -0.25$.

[1]

9 (a)

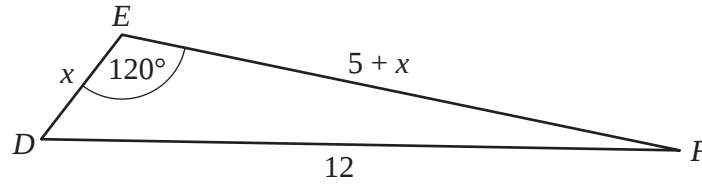
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In the diagram, $AC = 11$ cm, $BC = 5.5$ cm and $\hat{BAC} = 25^\circ$.
It is given that $\hat{ABC}$ is an **obtuse** angle.

Calculate $\hat{ABC}$.

Answer [4]

(b)



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In the diagram, $DF = 12$ cm, $DE = x$ centimetres and $EF = (5 + x)$ centimetres.

- (i) Form an equation in x and show that it reduces to $3x^2 + 15x - 119 = 0$.

[3]

- (ii) Solve the equation $3x^2 + 15x - 119 = 0$, giving each answer correct to 3 decimal places.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [4]

- (iii) Find the length of EF in millimetres, correct to the nearest millimetre.

Answer $\dots\dots\dots$ mm [1]

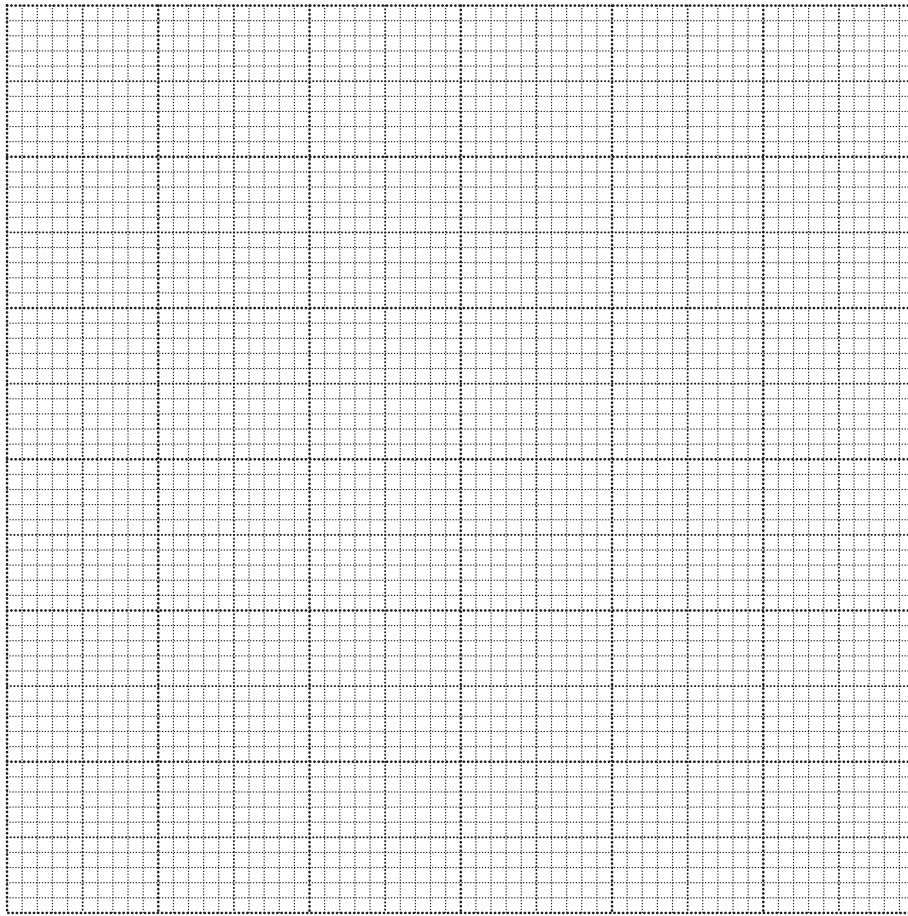
10 The distribution of the masses of 140 eggs is given in the table below.

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Mass (m grams)	$35 < m \leq 40$	$40 < m \leq 45$	$45 < m \leq 50$	$50 < m \leq 55$	$55 < m \leq 60$	$60 < m \leq 70$
Number of eggs	15	20	30	35	28	12

- (a)** Using a scale of 1 cm to represent 5 grams, draw a horizontal axis for $30 \leq m \leq 70$.
Using a scale of 1 cm to 1 unit, draw a vertical axis to represent frequency density.

Draw a histogram to represent the information in the table.



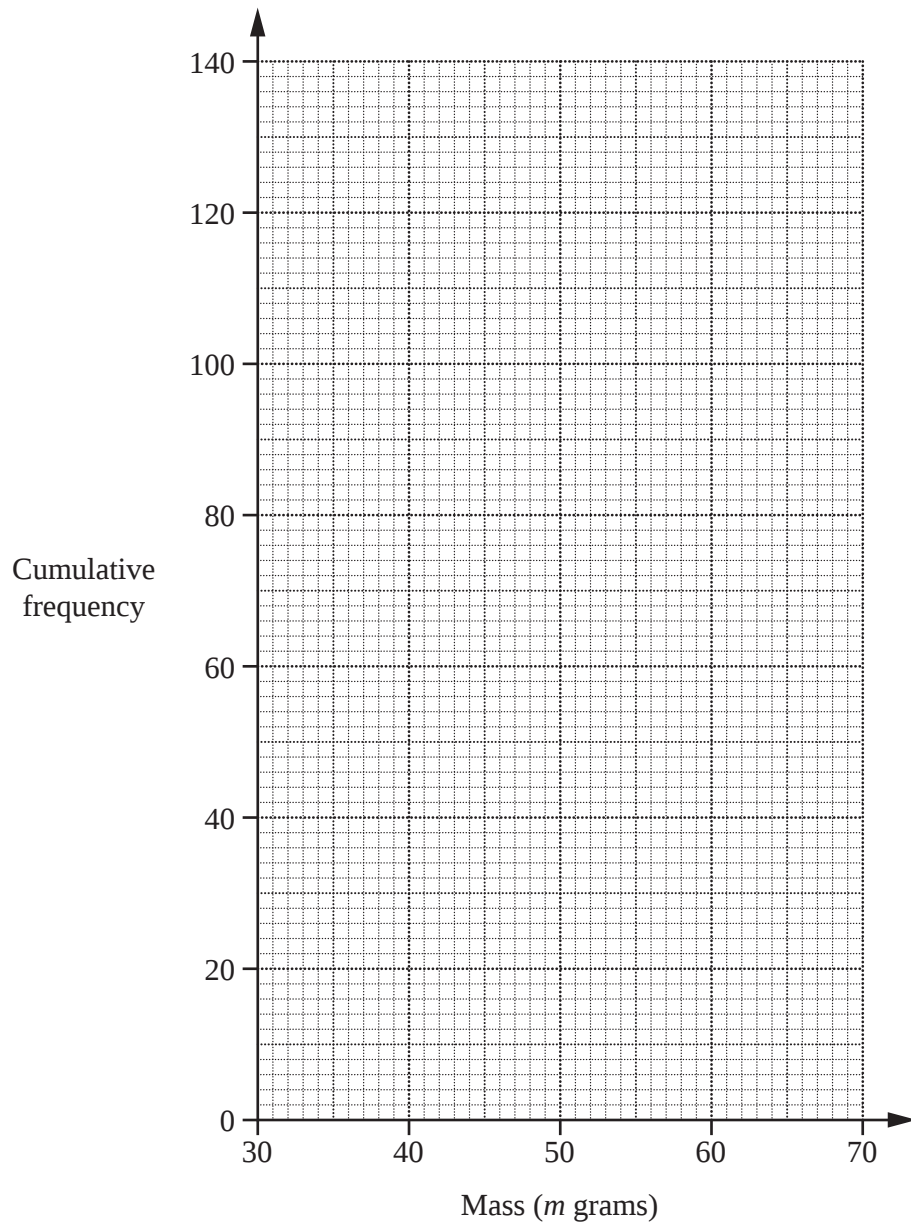
[3]

- (b) (i)** Complete the cumulative frequency table below.

Mass (m grams)	$m \leq 35$	$m \leq 40$	$m \leq 45$	$m \leq 50$	$m \leq 55$	$m \leq 60$	$m \leq 70$
Cumulative frequency	0	15					140

[1]

- (ii)** On the grid on the next page, draw a smooth cumulative frequency curve to represent this information.



[3]

(c) Use your graph to find

(i) the median mass of the eggs,

Answer g [1]

(ii) the interquartile range.

Answer g [2]

(d) The 12 eggs with the greatest mass are classed as extra large.
The 30 eggs with the least mass are classed as small.

Use your graph to find an estimate of the smallest difference in mass between an extra large egg and a small egg.

Answer g [2]

- 11 (a) Some transformations of the plane are given in the following table.

M_x	Reflection in the x -axis
M_y	Reflection in the y -axis
M_d	Reflection in the line $y = -x$
R_{90}	Rotation of 90° , anti-clockwise, centre the origin
R_{180}	Rotation of 180° , centre the origin
R_{270}	Rotation of 270° , anti-clockwise, centre the origin.

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You may use the grid on the next page to help answer the following questions.

- (i) The point A has coordinates $(2, 3)$.

- (a) Find the coordinates of $M_y(A)$.

Answer (.....,) [1]

- (b) Find the coordinates of $M_d M_y(A)$.

Answer (.....,) [1]

- (c) The inverse of R_{90} maps B onto A .

Find the coordinates of B .

Answer (.....,) [2]

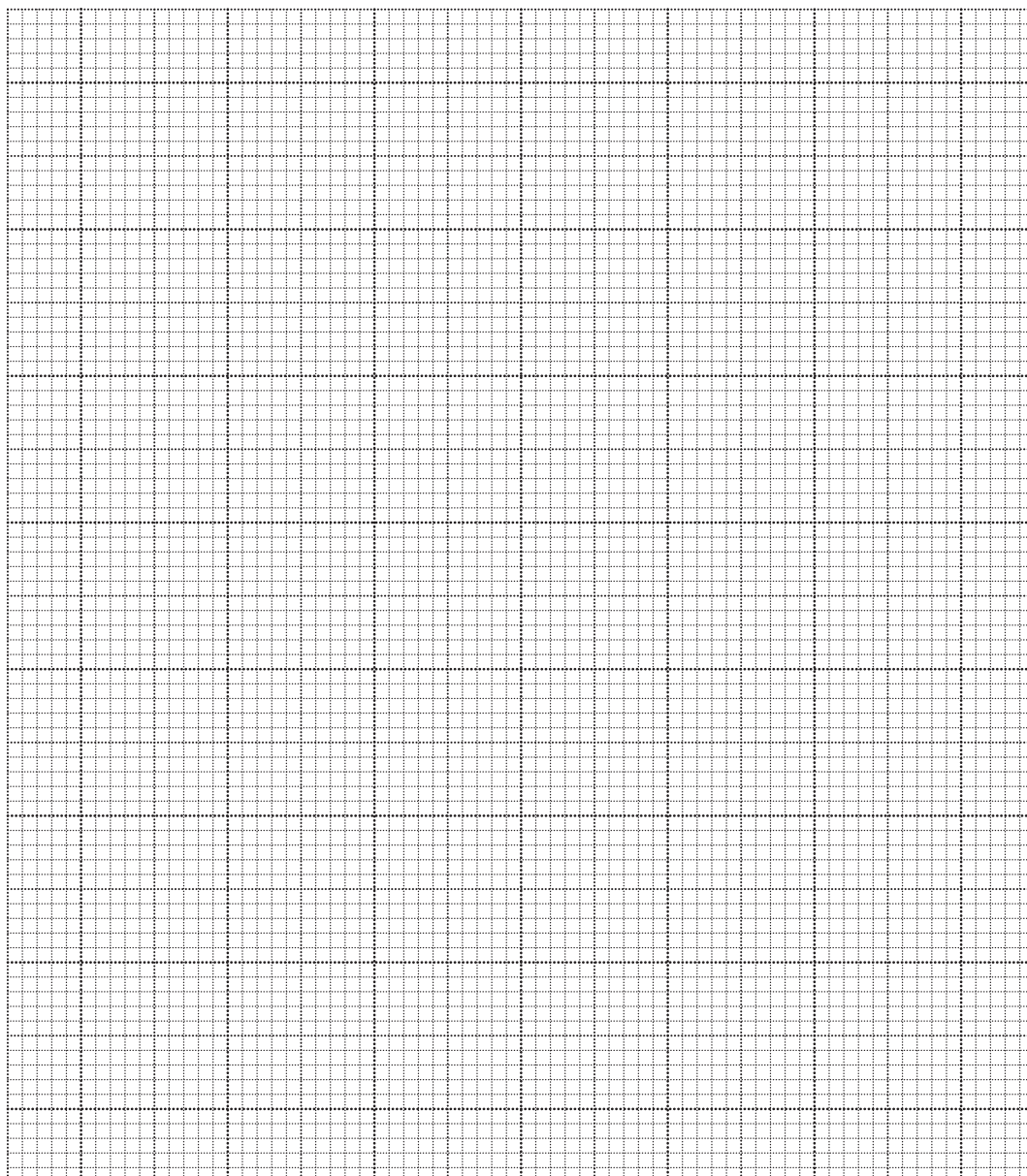
- (ii) (a) Write down the matrix which represents M_x .

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [1]

- (b) Which single transformation given in the table is equivalent to $R_{180} M_x$?

Answer [1]

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Turn over for the rest of this question.

- (b) The points P and Q have coordinates $(4, 0)$ and $(9, 0)$ respectively.
The points P' and Q' have coordinates $(4, 4)$ and $(7, 8)$ respectively.

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margin

- (i) Write down the length of PQ .

Answer $PQ = \dots\dots\dots$ units [1]

- (ii) Calculate the length of $P'Q'$.

Answer $P'Q' = \dots\dots\dots$ units [2]

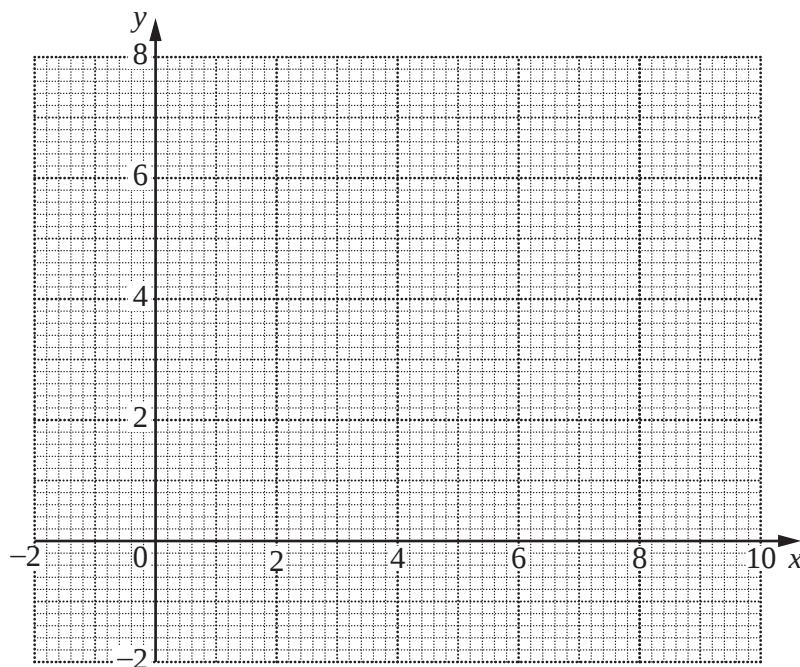
- (iii) PQ is mapped onto $P'Q'$ by a single rotation.
By using the grid below,

- (a) find, by drawing, the coordinates of the centre of this rotation,

Answer $(\dots\dots\dots, \dots\dots\dots)$ [2]

- (b) measure the clockwise angle of rotation.

Answer $\dots\dots\dots$ [1]



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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

October/November 2011

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

For Examiner's Use

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This document consists of **24** printed pages.



Section A [52 marks]Answer **all** questions in this section.Do not
write in this
margin

1 (a) $A = h(4m + h)$

Express m in terms of A and h .*Answer*[3]

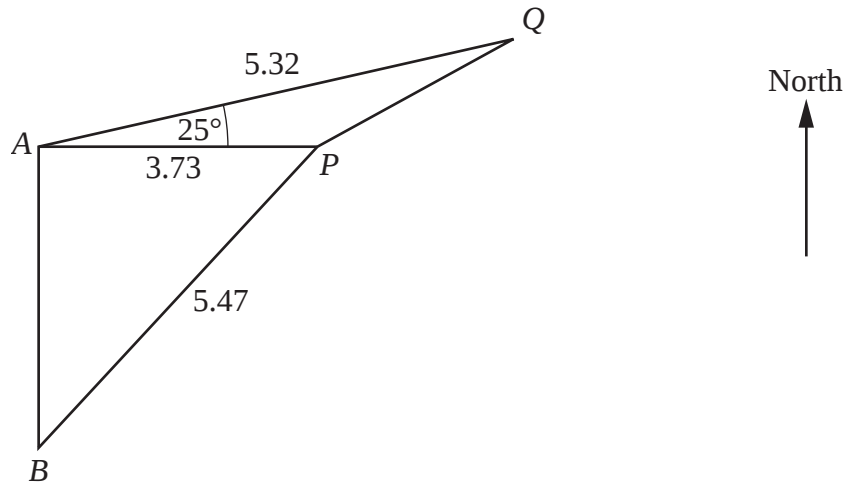
(b) Factorise completely $3ax + 5bx - 6ay - 10by$.

Answer[2]

(c) Solve the equation $\frac{5x-1}{9} = \frac{9}{5x-1}$.

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margin*

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]



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The diagram shows four points, A , B , P and Q , at sea.
 B is due South of A and P is due East of A .
 $AP = 3.73$ km, $BP = 5.47$ km, $AQ = 5.32$ km and $\angle PAQ = 25^\circ$.

(a) Calculate $\angle ABP$.

Answer[2]

(b) Calculate PQ .

Answerkm [4]

(c) A boat sailed in a straight line from Q to A .

(i) Find the bearing of A from Q .

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write in this
margin*

Answer [1]

(ii) A lighthouse is situated at A .

The top of the lighthouse is 30m above sea level.

Calculate the angle of depression of the boat from the top of the lighthouse when the boat is 100m from A .

Answer [2]

3 (a)

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Diagram I

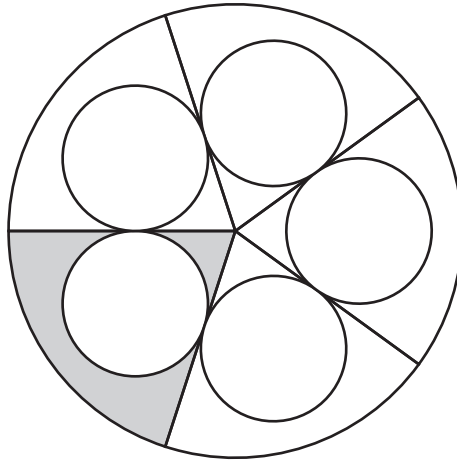


Diagram I shows one large circle and five identical small circles.
Each of the five radii shown is a tangent to two of the small circles.

- (i) Describe the symmetry of the diagram.

Answer [1]

- (ii) The radius of the large circle is R centimetres and the radius of each small circle is r centimetres.
Each small circle is equal in area to the shaded region.

Find $R^2 : r^2$.

Answer : [3]

(b)

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Diagram II

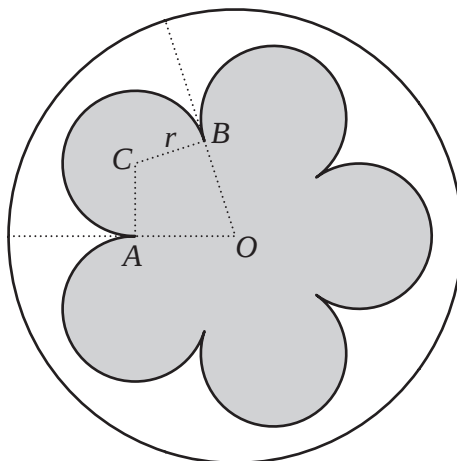


Diagram II shows the same large circle and arcs of the same small circles as in **Diagram I**. C is the centre of one of the small circles.

This circle touches the adjacent circles at A and B .

O is the centre of the large circle.

- (i) Show that reflex $\hat{ACB} = 252^\circ$.

[2]

- (ii) The perimeter of the shaded region is $k\pi r$ centimetres.

Calculate the value of k .

Answer [2]

- 4 (a) A shopkeeper buys some plates from a manufacturer for \$10 each.

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margin

- (i) (a) The shopkeeper sells a plate for \$12.

Calculate the percentage profit.

Answer% [1]

- (b) The shopkeeper buys 240 plates and sells 180 at \$12 each.
The rest were sold to a café for a total of \$540.

Calculate the percentage discount given to the café.

Answer% [2]

- (ii) The manufacturer made a profit of 60% when he sold each plate for \$10.

Calculate the cost of manufacturing each plate.

Answer \$..... [2]

- (b) Another shopkeeper bought 100 pans at \$5 each.
He sold 63 at \$6 each and x at \$4 each.
He did not sell all the pans nor enough to make an overall profit.

- (i) Form an inequality in x .

Answer [1]

- (ii) Hence find the greatest possible number of pans that were sold.

Answer [2]

- (c) One day, the rate of exchange between American dollars (\$) and British pounds (£) was $\$1.45 = \pounds 1$.

- (i) Alan changed £300 into dollars.

Calculate how many dollars he received.

Answer \$..... [1]

- (ii) On the same day, the rate of exchange between South African rands (R) and pounds was $\text{R}10.44 = \pounds 1$.

Calculate the number of rands received in exchange for one dollar.

Answer R..... [2]

5 (a) $\begin{pmatrix} 3 & -1 & 0 \\ 1 & 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ 11 \\ y \end{pmatrix} = \begin{pmatrix} 4 \\ 9 \end{pmatrix}.$

Find x and y .

Answer $x = \dots\dots\dots$

$y = \dots\dots\dots$ [2]

(b) (i) The transformation A is represented by the matrix $\begin{pmatrix} a & b \\ c & d \end{pmatrix}.$

Find, in terms of a , b , c and d as appropriate,

(a) the image of $(1, 0)$ under the transformation A,

Answer $(\dots\dots\dots, \dots\dots\dots)$ [1]

(b) the image of $(0, 1)$ under the transformation A.

Answer $(\dots\dots\dots, \dots\dots\dots)$ [1]

- (ii) The transformation B maps (1, 0) onto (1, 3) and (0, 1) onto (−3, −2).

Write down the matrix that represents transformation B.

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margin

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [1]

- (iii) Describe fully the transformation given by the matrix $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$.

Answer.....
.....[2]

- 6 You may use the graph paper on the next page to help answer this question.

The point A is $(0, 7)$, and the point B is $(6, 9)$.

- (a) Express $\overrightarrow{AB}$ as a column vector.

Answer [1]

- (b) Find the gradient of AB .

Answer [1]

- (c) The equation of the line AB is $x + Py + Q = 0$.

Find P and Q .

Answer $P =$
 $Q =$ [2]

- (d) The point C is $(12, 2)$.

- (i) Given that C is the midpoint of BM , find the coordinates of M .

Answer (.....,) [1]

- (ii) Calculate AC .

Answer units [1]

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write in this
margin

- (iii) The point D lies on the line AB .
The line CD is parallel to the y -axis.

(a) Find the coordinates of D .

Answer (..... ,) [2]

(b) Express $\overrightarrow{AD}$ in terms of $\overrightarrow{AB}$.

Answer $\overrightarrow{AD} = \dots\dots\dots$ [1]

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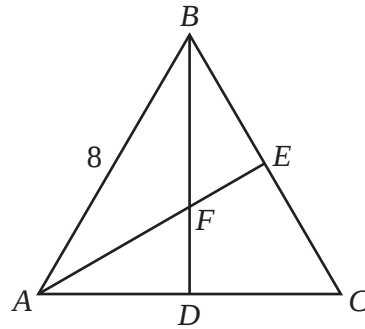
Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

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7

**Diagram I**

In **Diagram I**, ABC is an equilateral triangle of side 8 cm.
 D and E are the midpoints of AC and BC respectively.
 BD and AE intersect at F .

- (a) (i) Find the area of triangle ABC .

Answercm² [2]

- (ii) Show that $\hat{AFB} = 120^\circ$.

Answer
 [1]

- (iii) Calculate AF .

Answer cm [2]

- (b) [The volume of a pyramid = $\frac{1}{3} \times \text{base area} \times \text{height}$]

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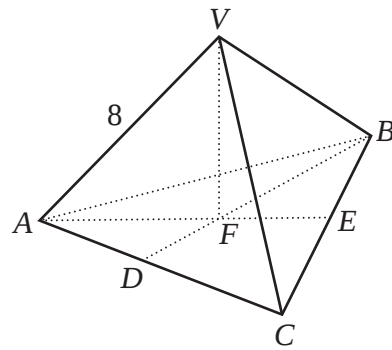


Diagram II

The equilateral triangle of side 8 cm in **Diagram I** forms the base of the triangular pyramid $VABC$ in **Diagram II**.

The vertex V is vertically above F .

$VA = VB = VC = 8$ cm.

- (i) Calculate the surface area of the pyramid.

Answercm² [1]

- (ii) Calculate the volume of the pyramid.

Answercm³ [3]

- (c) A pyramid P is geometrically similar to $VABC$ and its volume is $\frac{1}{64}$ of the volume of $VABC$.

- (i) Find the length of an edge of P .

Answer cm [2]

- (ii) A pyramid that is identical to P is removed from each of the four vertices of $VABC$.

State the number of faces of the new solid.

Answer [1]

- 8 Two companies, A and B, were started 10 years ago.
Initial investments of \$25 or multiples of \$25 could be made when Company A started business.

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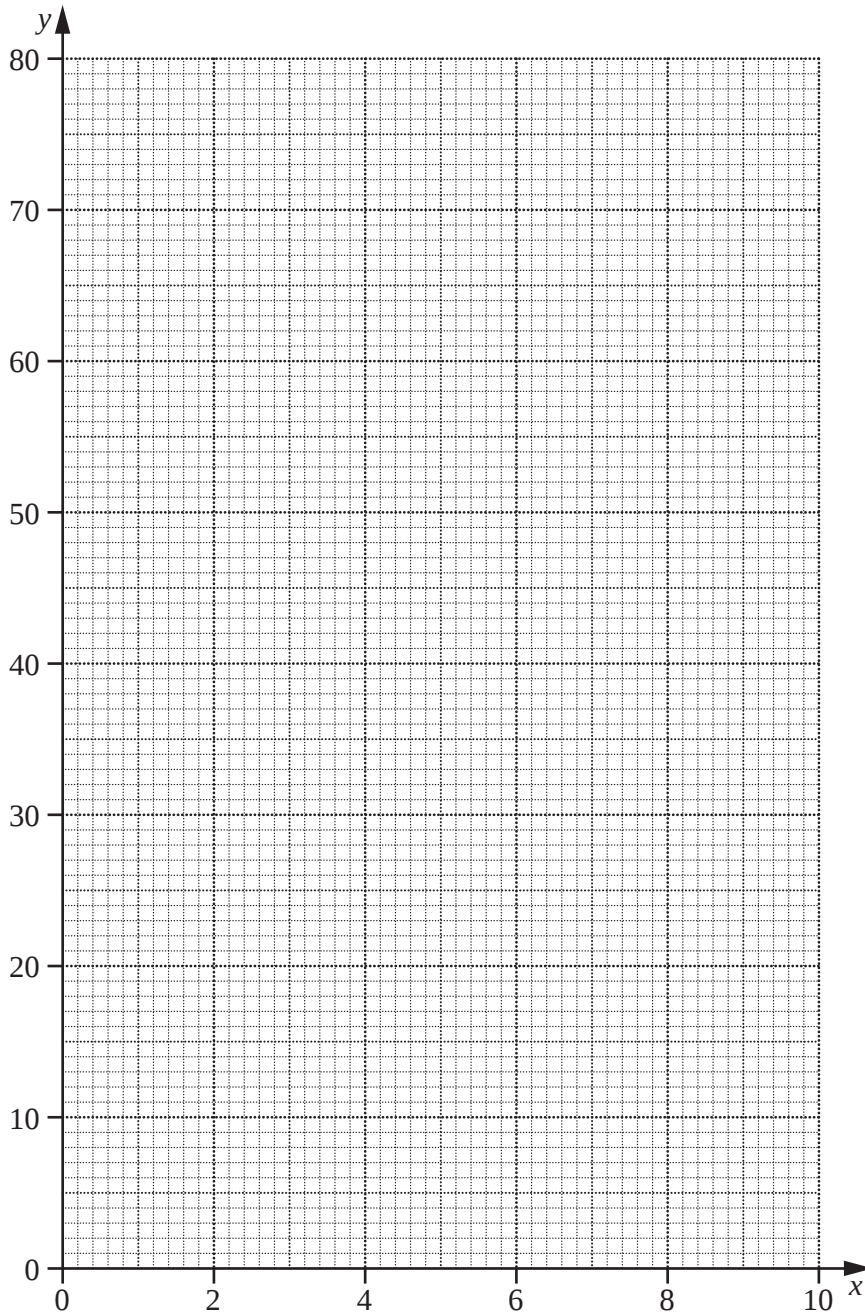
- (a) The table shows the value of an initial investment of \$25 at the end of each of the next 10 years.

Number of years (x)	0	1	2	3	4	5	6	7	8	9	10
Value in dollars (y)	25	28	31	35	39	44	49	55	62	69	78

- (i) Calculate the value of an initial investment of \$500 after 8 years.

Answer \$..... [1]

- (ii) On the grid, plot the points given in the table and join them with a smooth curve.



[2]

- (iii) Using your graph, find x when the value of an initial investment of \$100 had increased to \$168.

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Answer [1]

- (b) An initial investment of \$25 was made when company B started business.
The value, y dollars, after x years, is given by the equation $y = 3.75x + 25$.

- (i) Calculate the value of an initial investment of \$500 after 8 years.

Answer \$..... [1]

- (ii) On the grid, draw the graph of $y = 3.75x + 25$. [2]

- (c) Using your graphs, find the value of x when an initial investment of \$25 had increased to the same value in each company.

Answer [1]

- (d) (i) By drawing a tangent to the graph representing an investment in company A, find the rate of increase of this investment when $x = 7$.

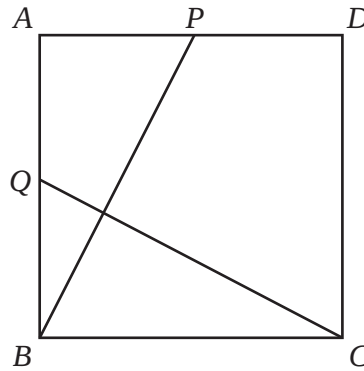
Answer [2]

- (ii) **State** the rate of increase of an investment in company B.

Answer [1]

- (iii) By drawing another tangent to the graph representing an investment in company A, find the value of x when the rates of increase of investments in each company were the same.

Answer [1]

Diagram I

In **Diagram I**, $ABCD$ is a square.
 P and Q are the midpoints of AD and AB respectively.

- (a) Show that triangles APB and BQC are congruent.

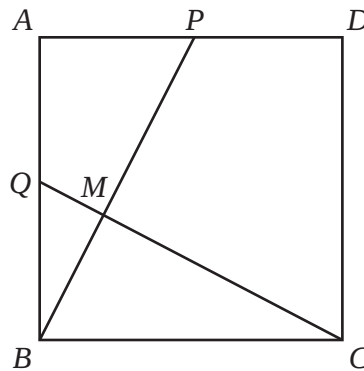
Answer

.....

.....

..... [3]

- (b)

Diagram II

In **Diagram II**, QC and PB intersect at M .

Show that $\hat{BMC} = 90^\circ$.
 State your reasons clearly.

Answer

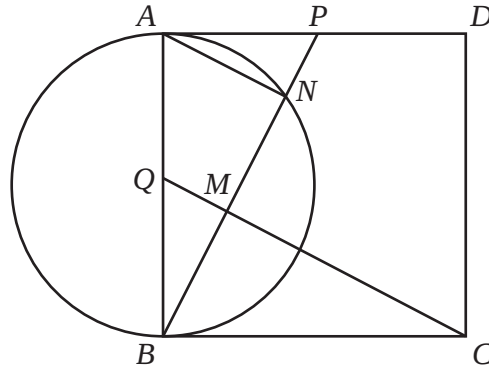
.....

..... [2]

(c)

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Diagram III



In **Diagram III**, the circle centre Q has diameter AB .
The circle intersects BP at N .

- (i) State the reason why $\angle ANB = 90^\circ$.

Answer [1]

- (ii) Triangle BMQ is mapped onto triangle BNA by an enlargement.
Write down the centre and scale factor of the enlargement.

Answer
..... [1]

- (iii) Given that $QM = 3$ cm,

- (a) find AN ,

Answer cm [1]

- (b) show that $MN = 6$ cm,

Answer
..... [1]

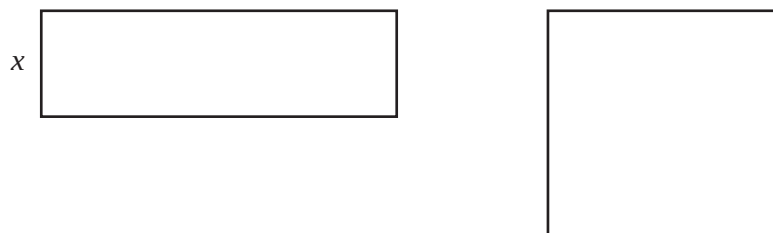
- (c) find MC ,

Answer cm [1]

- (d) find the area of triangle APB .

Answer cm² [2]

10



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A piece of wire, 28 cm in length, is cut into two parts.
One part is used to make a rectangle and the other a square.

The length of the rectangle is three times its width.
The width of the rectangle is x centimetres.

(a) (i) Write down an expression, in terms of x , for the length of the rectangle.

Answer cm [1]

(ii) Find, and simplify, an expression, in terms of x , for the length of a side of the square.

Answer cm [2]

(b) It is given that the area of the rectangle is equal to the area of the square.

(i) Form an equation in x and show that it reduces to $x^2 - 28x + 49 = 0$.

[2]

- (ii) Solve the equation $x^2 - 28x + 49 = 0$, giving each solution correct to 3 significant figures.

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margin

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [4]

- (iii) Which solution represents the width of the rectangle?
Give a reason for your answer.

Answer The width of the rectangle is $\dots\dots\dots$ cm because $\dots\dots\dots$
 $\dots\dots\dots$ [2]

- (iv) Calculate the area of the square.

Answer $\dots\dots\dots$ cm² [1]

- 11 (a)** A sports club has 120 members.
The cumulative frequency table for their ages is shown below.

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Age (x years)	$x \leq 5$	$x \leq 15$	$x \leq 25$	$x \leq 35$	$x \leq 45$	$x \leq 55$	$x \leq 65$
Cumulative frequency	0	12	30	60	96	114	120

- (i)** On the grid on the next page
draw a horizontal x -axis for $0 \leq x \leq 70$, using a scale of 2 cm to represent 10 years
and a vertical axis from 0 to 120, using a scale of 2 cm to represent 20 members.

On your axes draw a smooth cumulative frequency curve to illustrate the information
in the table. [3]

- (ii)** Find the upper quartile age.

Answeryears [1]

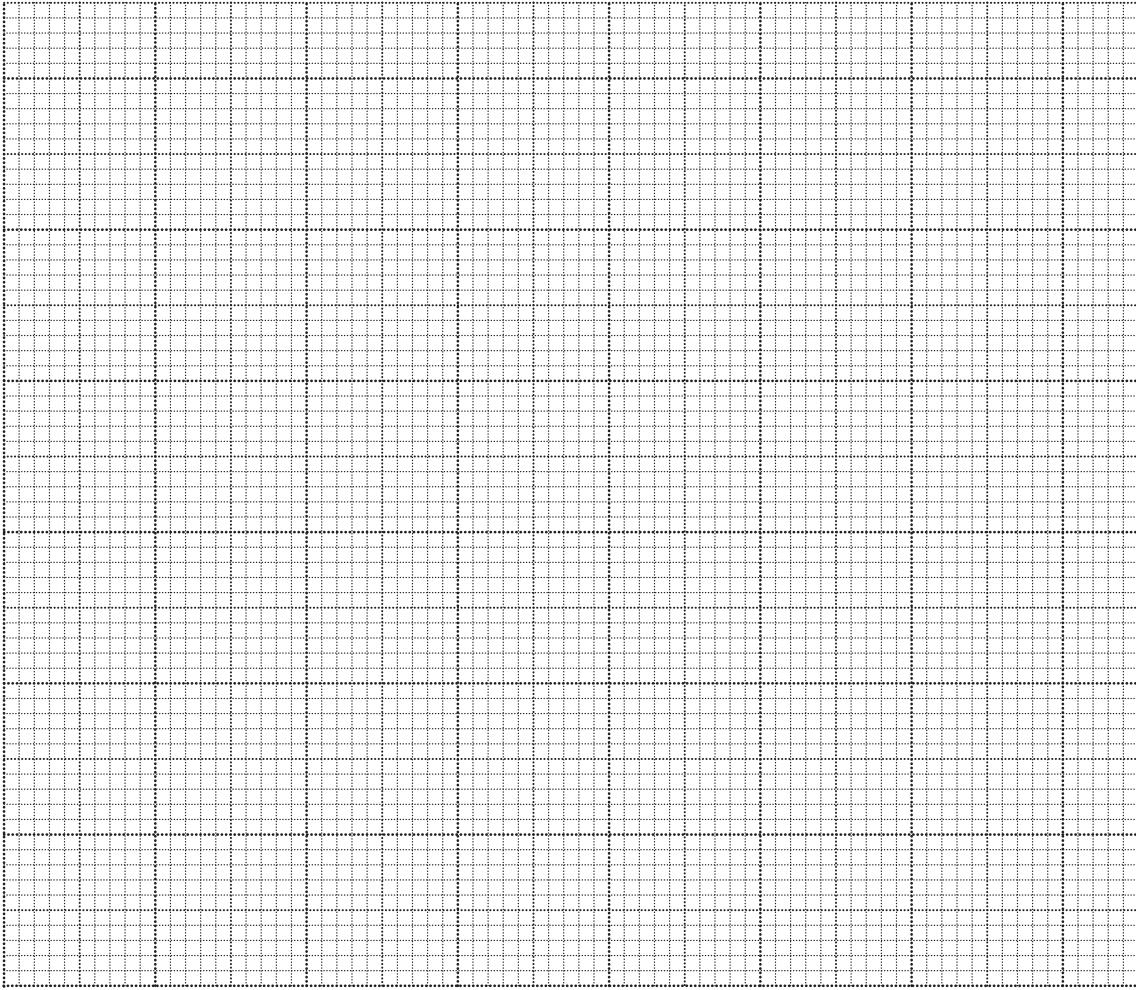
- (iii)** Find the interquartile range of the ages.

Answeryears [1]

- (iv)** Members who are not more than 15, and members who are over 50, pay reduced fees.
Use your graph to find an estimate of the number of members who pay reduced fees.

Answer [1]

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margin*



Turn over for the rest of this question.

- A disc is picked out at random and not replaced.
A second disc is then picked out at random and not replaced.

First disc

The left diagram shows a game tree starting from a single node on the left. It branches into two nodes on the right. The upper branch is labeled "Blue" and the lower branch is labeled "Red".

The right diagram shows a game tree starting from a single node on the left. It branches into three nodes on the right. The upper branch is labeled "Blue", the middle branch is labeled "Red", and the lower branch is labeled $\frac{3}{11}$.

- (ii) Expressing each of your answers as a fraction **in its lowest terms**, calculate the probability that

- Answer* [1]

- Answer* [2]

- Answer* [1]

4024/22/O/N/11



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

October/November 2012

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

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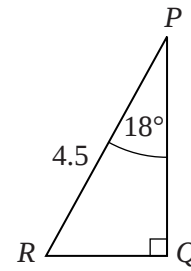
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This document consists of **23** printed pages and **1** blank page.



Section A [52 marks]Answer **all** questions in this section.Do not
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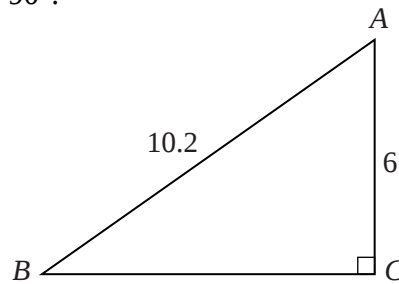
- 1 (a) In triangle PQR , $\hat{R}PQ = 18^\circ$, $\hat{P}QR = 90^\circ$ and $PR = 4.5$ m.

Find PQ .

Answer m [2]

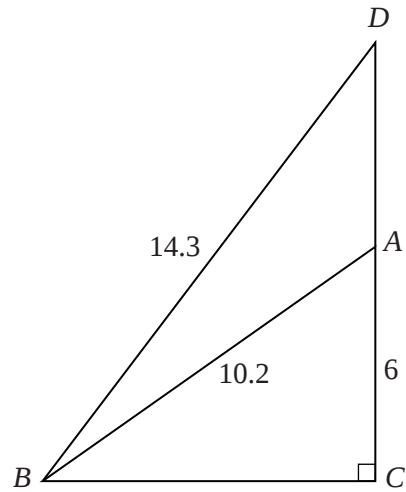
- (b) In triangle ABC , $AB = 10.2$ m, $AC = 6$ m and $\hat{A}CB = 90^\circ$.

- (i) Find $\hat{A}BC$.



Answer [2]

(ii)

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margin

D is the point on CA produced such that $BD = 14.3$ m.

Find AD .

Answer m [4]

- 2 (a) (i) Simplify $5p - (1 - 5p) + 2$.

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margin

Answer [2]

- (ii) Solve the inequality $3 - 2x > 5$.

Answer [2]

(b) $y = \frac{A + 2x}{x}$.

- (i) Find y when $x = A$.

Answer $y =$ [1]

- (ii) Rearrange the formula to make x the subject.

Answer $x =$ [3]

- (c) Ada is x years old and Bill is y years old.
Last year, Bill was 6 times as old as Ada.

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write in this
margin*

- (i) Form an equation in x and y and show that it simplifies to $y = 6x - 5$.

[1]

- (ii) In 19 years time, Bill will be twice as old as Ada.

Form another equation in x and y and show that it simplifies to $y = 2x + 19$.

[1]

- (iii) Hence find the present ages of Ada and Bill.

Answer Ada's age years

Bill's age years [2]

- 3 Matthew makes pieces of furniture and sends them to a shop where they are sold. When a piece is sold, the shopkeeper receives 15% of the selling price, and Matthew receives the rest.

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write in this
margin*

(a) A table is sold for \$200.

(i) Calculate the amount the shopkeeper receives.

Answer \$ [1]

(ii) The cost of making this table was \$131.80.

Calculate the percentage profit that Matthew makes when this table is sold.

Answer % [3]

(b) Matthew made a bookcase.

The cost of making the bookcase was \$647.50.

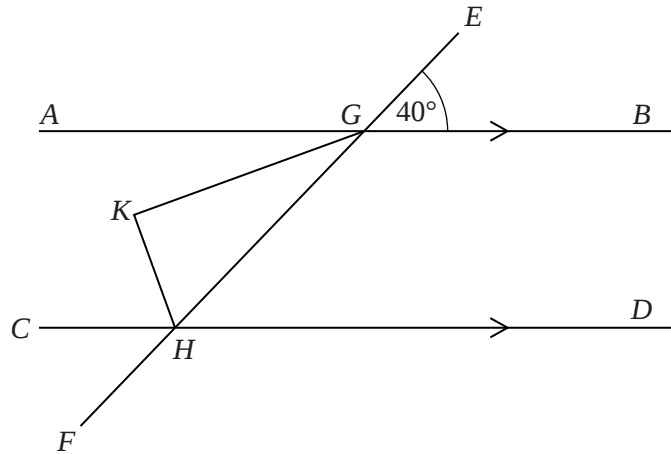
After the bookcase is sold and the shopkeeper has received 15% of the selling price, Matthew makes a profit of \$160.

Calculate the selling price of the bookcase.

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write in this
margin*

Answer \$[3]

- 4 (a) AB and CD are parallel.
 $EGHF$ is a straight line.
 GK bisects $\widehat{AGH}$ and
 HK bisects $\widehat{CHG}$.
 $\widehat{EGB} = 40^\circ$.



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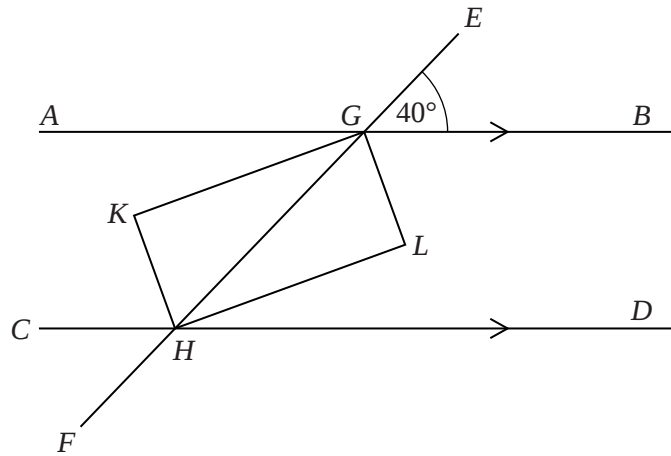
- (i) Find $\widehat{KGH}$.

Answer [1]

- (ii) Find $\widehat{GKH}$.

Answer [1]

- (iii) The bisectors of $\widehat{HGB}$ and $\widehat{DHG}$ intersect at L .



State the name of the special quadrilateral $HKGL$ and give your reasons.

Answer $HKGL$ is a

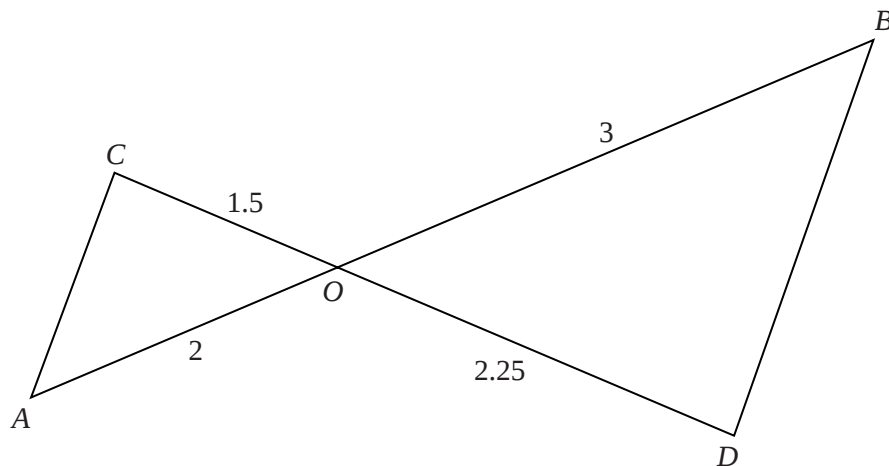
because

.....

.....[3]

(b) AOB and COD are straight lines.

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margin



(i) Show that triangles OCA and ODB are similar.

Answer

.....

.....

..... [2]

(ii) Given that $BD = 2.7$ cm, find AC .

Answer cm [1]

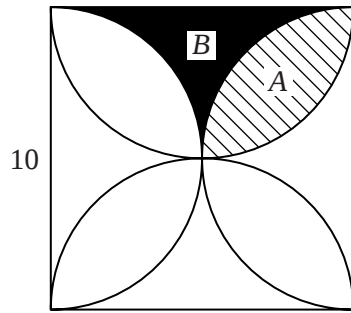


Diagram I



In **Diagram I**, four semicircles are drawn inside a square of side 10 cm. Each semicircle has a side of the square as its diameter. Two regions, *A* and *B*, are shown.

- (a) Calculate the perimeter of region *A*.

Answer cm [1]

- (b) Calculate the perimeter of region *B*.

Answer cm [1]

- (c)

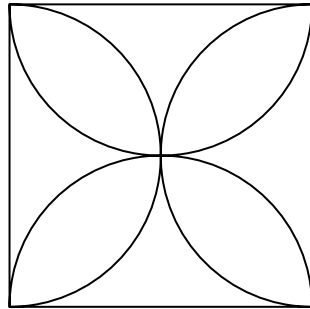


Diagram II

For **Diagram II**,

- (i) draw all the lines of symmetry, [1]
(ii) state the order of rotational symmetry.

Answer [1]

- (d) **Diagram III** shows the combined regions *A* and *B* shaded.

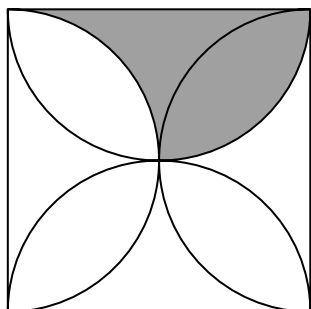


Diagram III

- (i) Calculate the area of this shaded region.

Answercm² [1]

- (ii) Hence calculate the area of region *A* shown in **Diagram I**.

Answercm² [3]

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write in this
margin*

6 The journey times of 80 drivers are summarised in the table.

Time (t minutes)	$60 < t \leq 80$	$80 < t \leq 90$	$90 < t \leq 95$	$95 < t \leq 100$	$100 < t \leq 110$	$110 < t \leq 130$
Number of drivers	4	10	14	20	24	8

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write in this
margin

(a) Calculate an estimate of the mean journey time.

Answer minutes [3]

(b) (i) A driver is chosen at random.

Find the probability that the journey time for this driver is 95 minutes or less.

Answer [1]

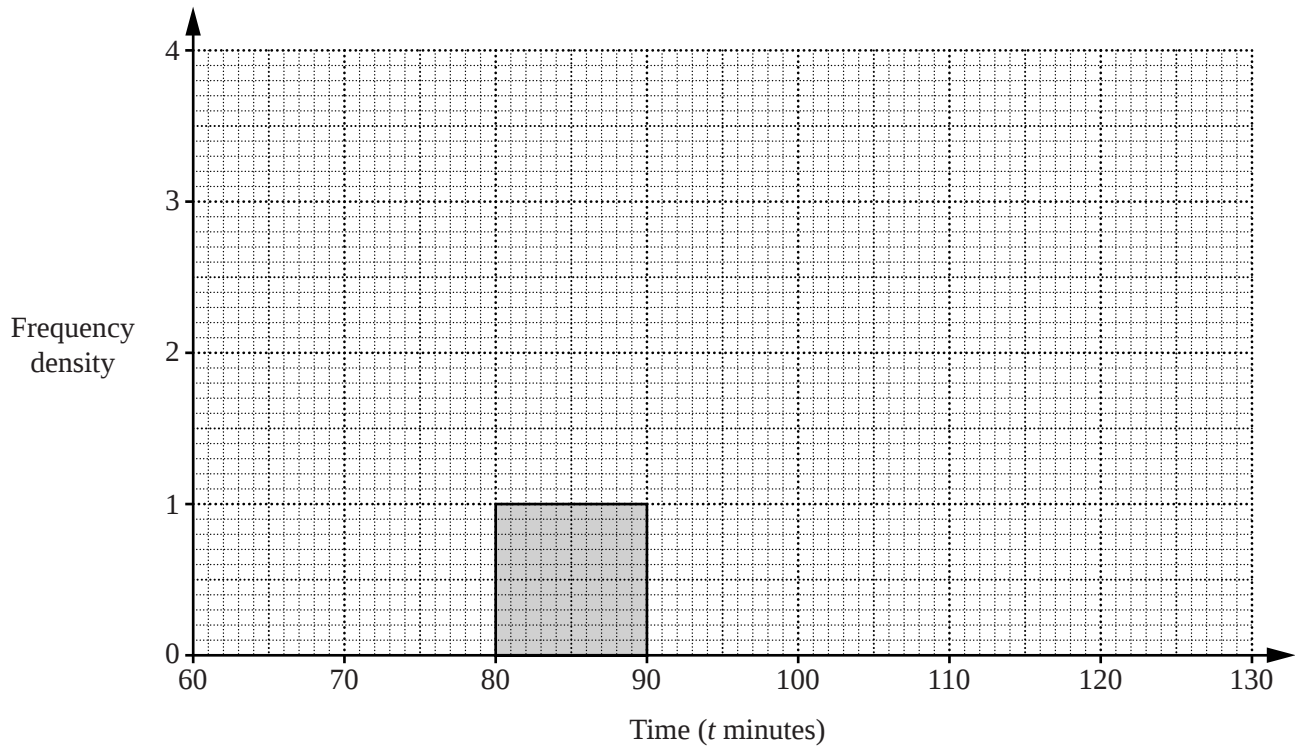
(ii) Two drivers are chosen at random without replacement.

Calculate the probability that both their journey times are more than 100 minutes.

Answer [2]

(c) Complete the histogram to represent the information in the table.

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write in this
margin



[3]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

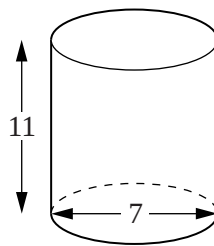
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- 7 (a) Tuna chunks are sold in cylindrical tins.
The 130 g tin costs \$1.00 and the 185 g tin costs \$1.50.

Which one is the better value for money?
Show all your working.

Answer [2]

- (b) A closed cylindrical tin is 11 cm high and the base has a diameter of 7 cm.



- (i) Calculate the volume of this tin.

Answer cm^3 [2]

- (ii) Calculate the total external surface area of this tin.

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Answercm² [3]

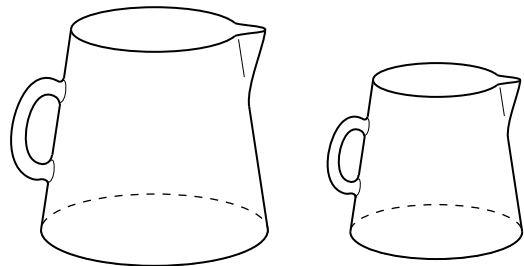
- (iii) In addition to the surface area, a closed tin requires an extra 30 cm² of metal to allow the top, bottom and side to be joined together.

Calculate the area of metal required for 30 000 closed tins.
Give your answer in square metres.

Answer m² [2]

- (c) Two geometrically similar jugs have volumes of 1000 cm³ and 512 cm³. They have circular bases. The diameter of the base of the larger jug is 9 cm.

Calculate the diameter of the base of the smaller jug.



Answer cm [3]

- 8 The variables x and y are connected by the equation

$$y = x^3 - 2x^2 + 1.$$

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margin

The table below shows some values of x and the corresponding values of y , correct to 1 decimal place where appropriate.

x	-1	-0.5	0	0.5	1	1.5	2	2.5
y	-2	0.4	1	0.6	0	-0.1	1	p

- (a) Calculate p . Give your answer correct to 1 decimal place.

Answer $p = \dots\dots\dots$ [1]

- (b) On the graph paper opposite, using a scale of 2 cm to represent 1 unit on both axes, draw a horizontal x -axis for $-2 \leq x \leq 3$ and draw a vertical y -axis for $-3 \leq y \leq 5$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]

- (c) Use your graph to find all the solutions of $x^3 - 2x^2 + 1 = 0$.

Answer $x = \dots\dots\dots$ [2]

- (d) By drawing a tangent, find the gradient of the curve at the point where $x = -0.3$.

Answer $\dots\dots\dots$ [2]

- (e) The equation $x^3 - 2x^2 - x + 2 = 0$ can be solved by finding the intersection of the graphs of $y = x^3 - 2x^2 + 1$ and the straight line $y = x + a$.

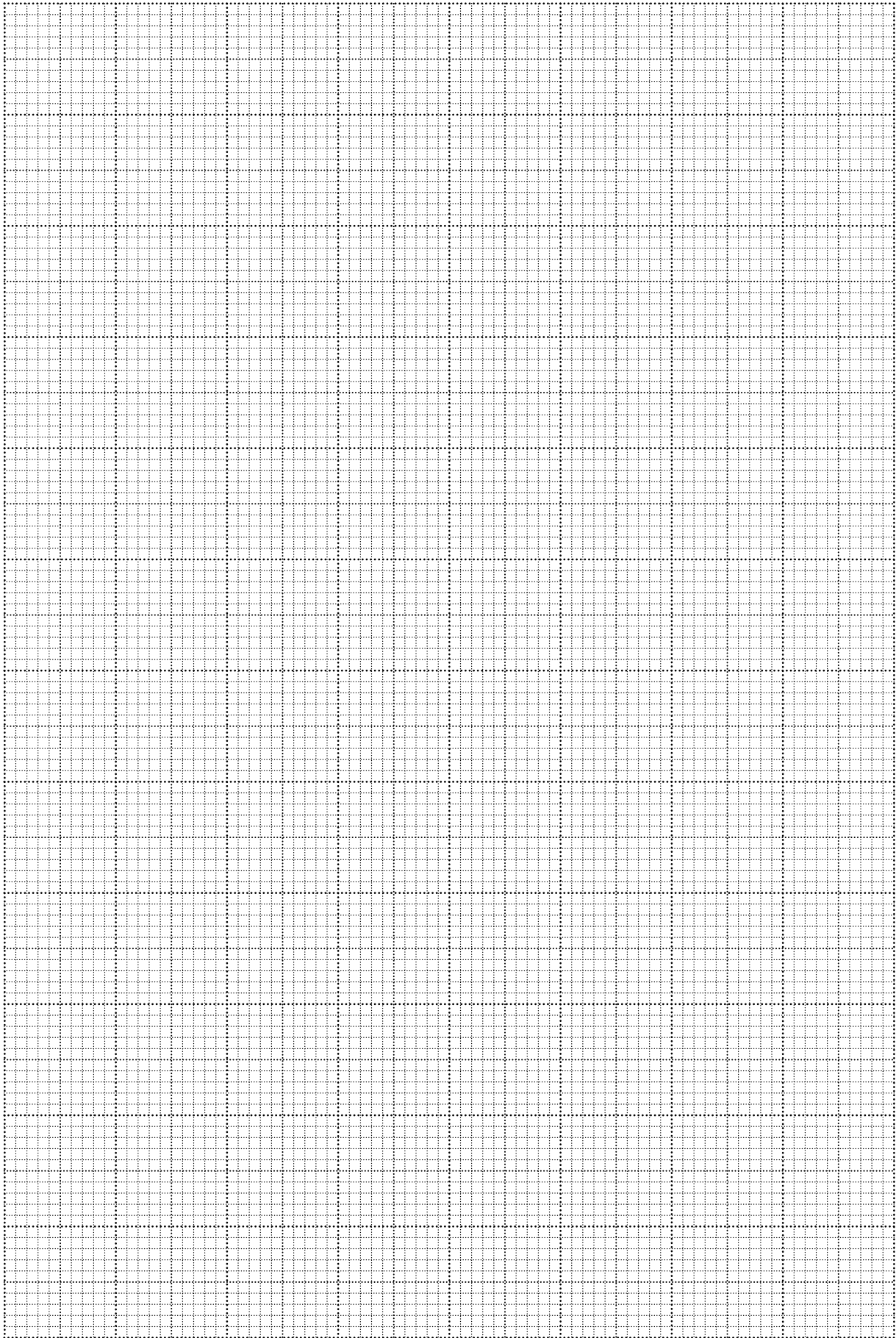
- (i) Find the value of a .

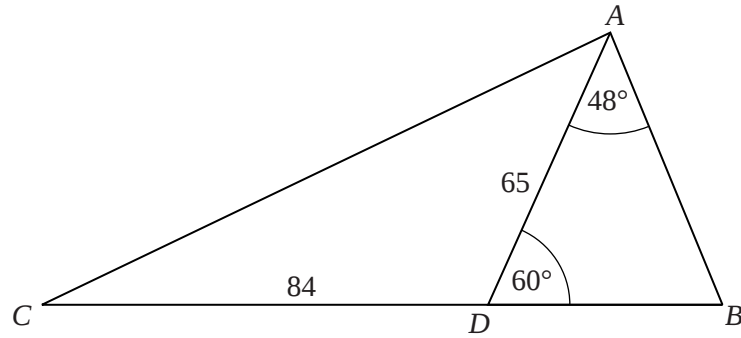
Answer $a = \dots\dots\dots$ [1]

- (ii) Hence solve the equation $x^3 - 2x^2 - x + 2 = 0$.

Answer $x = \dots\dots\dots$ [3]

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write in this
margin





A , B , C and D are four points on horizontal ground.

CDB is a straight line.

$AD = 65\text{ m}$ and $CD = 84\text{ m}$.

$\hat{DAB} = 48^\circ$ and $\hat{ADB} = 60^\circ$.

(a) Calculate AB .

Answerm [3]

(b) Calculate the area of triangle ACD .

Answer m^2 [2]

(c) Calculate AC .

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margin*

Answerm [4]

(d) A vertical tree of height 35 m stands at A .

P is the point on the line BC such that the angle of elevation from the line BC to the top of the tree is greatest.

Calculate this angle of elevation.

Answer [3]

- 10 London is 320 km from York.

A train travels from York to London at an average speed of x kilometres per hour.

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margin

- (a) Write down an expression, in terms of x , for the time taken, in hours, for this train to travel from York to London.

Answer h [1]

- (b) A car travels from York to London.

The average speed of the car is 80 km/h slower than the average speed of the train.

Write down an expression, in terms of x , for the time taken, in hours, for the car to travel from York to London.

Answer h [2]

- (c) The car took $2\frac{1}{2}$ hours longer than the train.

Form an equation in x and show that it simplifies to $x^2 - 80x - 10\,240 = 0$.

[3]

- (d) Solve this equation, giving each solution correct to 1 decimal place.

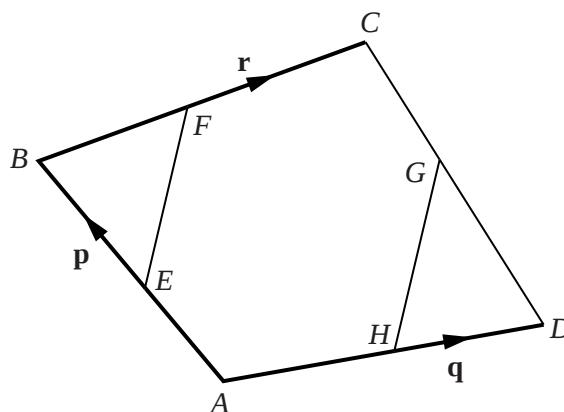
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Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [4]

- (e) Hence find the time taken by the **train** to travel from York to London.
Give your answer in hours and minutes, correct to the nearest minute.

Answer $\dots\dots\dots$ hours $\dots\dots\dots$ minutes [2]

- 11 (a) E, F, G and H are the midpoints of AB, BC, CD and DA respectively.
 $\vec{AB} = \mathbf{p}$, $\vec{AD} = \mathbf{q}$ and $\vec{BC} = \mathbf{r}$.



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write in this
margin

- (i) Find, in terms of $\mathbf{p}$, $\mathbf{q}$ and $\mathbf{r}$ as appropriate

(a) $\vec{EF}$,

Answer[1]

(b) $\vec{DC}$,

Answer[1]

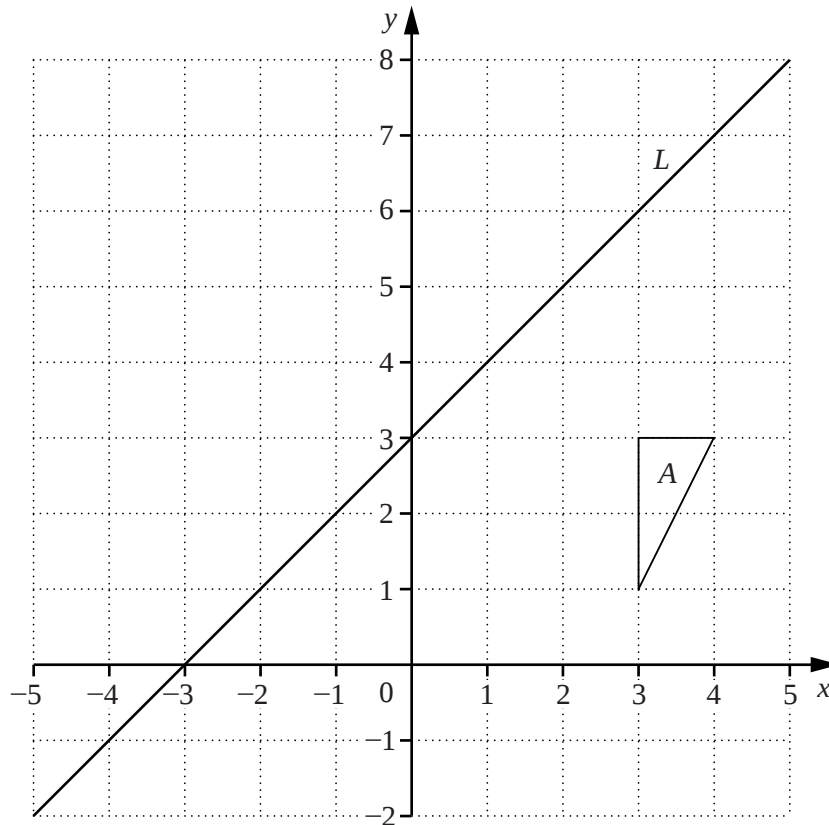
(c) $\vec{HG}$, expressing the vector as simply as possible.

Answer[2]

- (ii) What conclusions can be drawn about the lines EF and HG ?

Answer
[1]

(b)

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margin

The grid shows triangle *A* and line *L*.

- (i) Triangle *A* is mapped onto triangle *B* by a reflection in line *L*.

Draw and label triangle *B*.

[2]

- (ii) Triangle *A* is mapped onto triangle *C* by a clockwise rotation of 90° , centre $(0, 3)$.

Draw and label triangle *C*.

[2]

- (iii) Triangle *C* is mapped onto triangle *D* by a reflection in line *L*.

Describe the single transformation that maps triangle *B* onto triangle *D*.

Answer

.....[3]

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

October/November 2012

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

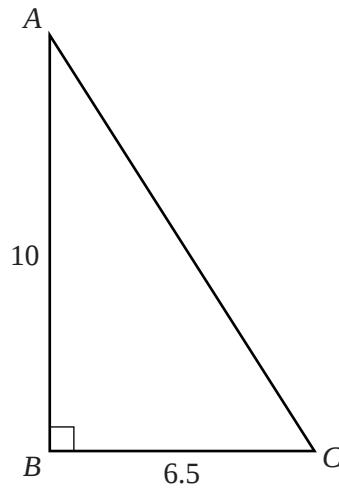
The total of the marks for this paper is 100.

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This document consists of **23** printed pages and **1** blank page.



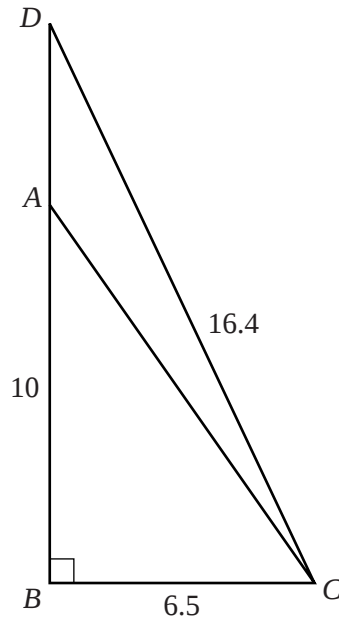
Section A [52 marks]Answer **all** questions in this section.Do not
write in this
margin**1**

In triangle ABC , $AB = 10\text{ m}$, $BC = 6.5\text{ m}$ and $\hat{ABC} = 90^\circ$.

(a) Find $\hat{ACB}$.

Answer [2]

(b)

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margin

D is the point on BA produced such that $CD = 16.4$ m.

- (i) Find AD .
Give your answer in metres and centimetres, correct to the nearest centimetre.

Answer m cm [3]

- (ii) Find $\hat{DCB}$.

Answer [2]

- 2 (a) Factorise $4x^2 - 1$.

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write in this
margin

Answer [1]

(b) $P = \frac{2Q + R}{R}$

- (i) Find P when $R = Q$.

Answer $P =$ [1]

- (ii) Rearrange the formula to make R the subject.

Answer $R =$ [3]

- (c) Solve the simultaneous equations.

$$\begin{aligned} 3x + 4y &= 17 \\ 2x - 5y &= 19 \end{aligned}$$

Answer $x =$

$y =$ [3]

- (d) A shopkeeper sells cartons of milk and bottles of water.
Each carton of milk costs \$2.40, and each bottle of water costs \$0.80.
One day he sells x cartons of milk.
On the same day, he sells 20 more bottles of water than cartons of milk.

- (i) Write down an expression, in terms of x , for the number of dollars he receives from the sale of these cartons and bottles.
Simplify your answer.

Answer [2]

- (ii) The total amount he receives that day from the sale of these cartons and bottles is greater than \$250.

Form an inequality in x and solve it.

Answer [2]

- (iii) Hence write down the least number of cartons of milk that he sells that day.

Answer [1]

3 (a) In 2009 the cost of posting a letter was 36 cents.

(i) A company posted 3000 letters and was given a discount of 4%.

Calculate the total discount given.
Give your answer in dollars.

Answer \$ [1]

(ii) In 2010, the cost of posting a letter was increased from 36 cents to 45 cents.

Calculate the percentage increase.

Answer% [2]

(iii) After the price increase to 45 cents, the cost to the company of posting 3000 letters was \$1302.75.

Calculate the new percentage discount given.

Answer% [2]

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(b) In 2010, it cost \$5.40 to post a parcel.

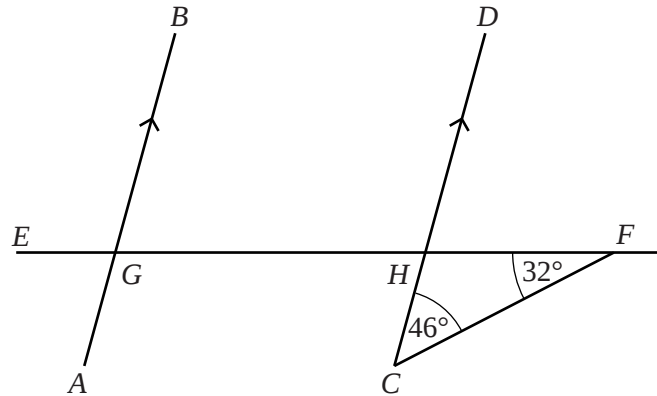
This was an increase of $12\frac{1}{2}\%$ on the cost of posting the parcel in 2009.

Calculate the increase in the cost of posting this type of parcel in 2010 compared to 2009.

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Answer \$ [3]

4 (a)

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AB and CD are parallel.
 $EGHF$ is a straight line.
 $\hat{HCF} = 46^\circ$ and $\hat{HFC} = 32^\circ$.

(i) Find $\hat{CHF}$.

Answer [1]

(ii) Find $\hat{GHD}$.

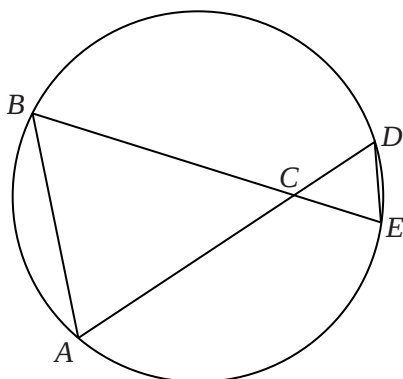
Answer [1]

(iii) Find $\hat{HGB}$.

Answer [1]

- (b) A, B, D and E are points on a circle.

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AD and BE intersect at C .

- (i) Show that triangles ABC and EDC are similar.
Give your reasons.

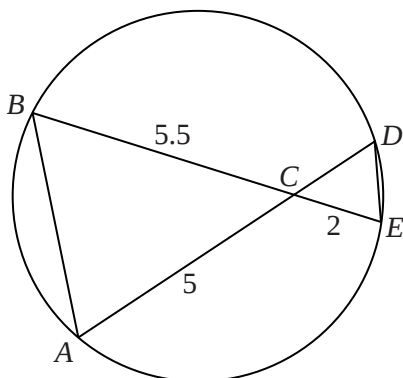
Answer

.....

.....

..... [2]

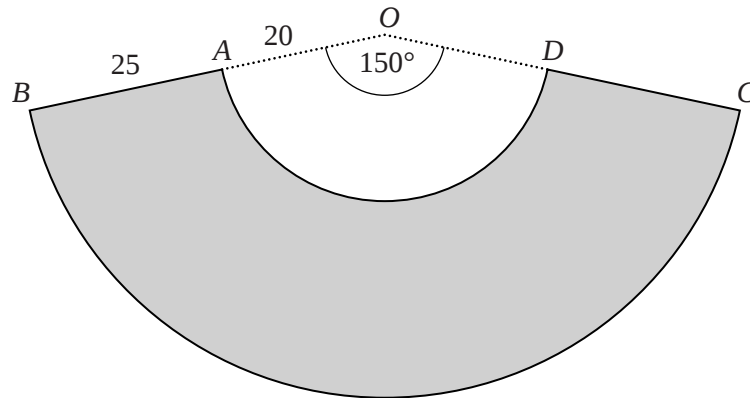
(ii)



Given that $AC = 5$ cm, $BC = 5.5$ cm and $CE = 2$ cm, find the length of the chord AD .

Answer cm [2]

5

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AD and BC are arcs of circles with centre O .
 A is a point on OB , and D is a point on OC .
 $OA = 20$ cm and $AB = 25$ cm.
 $\angle AOD = 150^\circ$.

(a) Calculate the perimeter of the shaded shape $ABCD$.

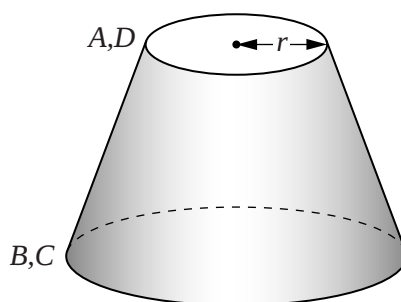
Answer cm [3]

- (b) Calculate the area of the shaded shape $ABCD$.

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write in this
margin

Answer cm^2 [3]

- (c) The shape $ABCD$ is used to make a lampshade by joining AB and DC .



Calculate the radius, r cm, of the circular top of the lampshade.

Answer cm [2]

- 6 The heights of 150 children are measured.
The results are summarised in the table.

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Height (h cm)	$130 < h \leq 140$	$140 < h \leq 150$	$150 < h \leq 155$	$155 < h \leq 160$	$160 < h \leq 170$	$170 < h \leq 190$
Frequency	10	30	20	30	35	25

- (a) Calculate an estimate of the mean height.

Answer cm [3]

- (b) (i) One child is chosen at random.

Find the probability that this child has a height greater than 160 cm.

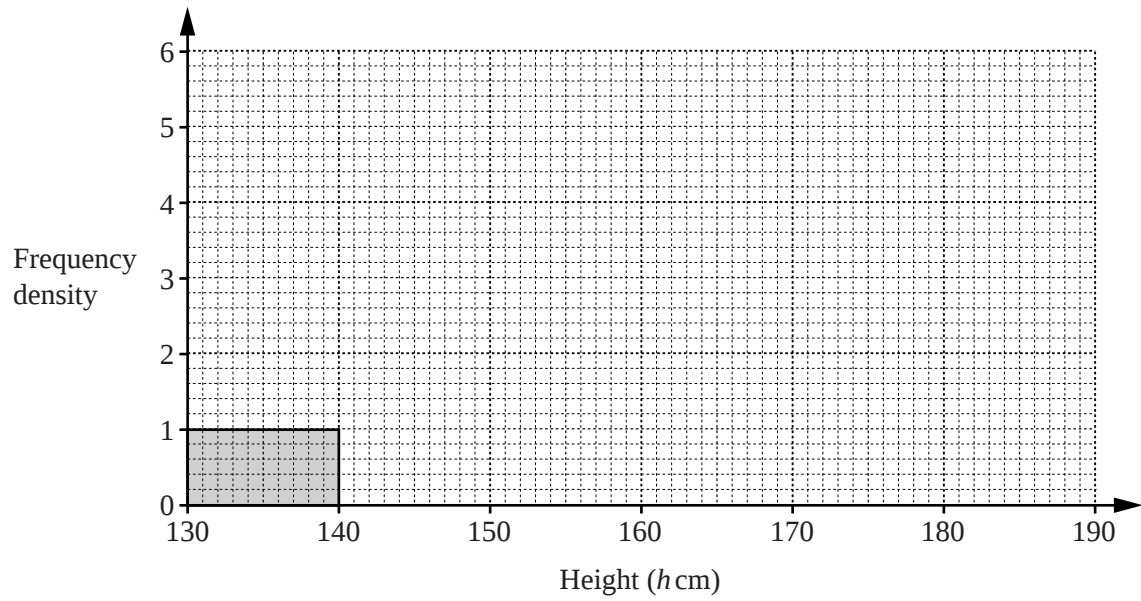
Answer [1]

- (ii) Two children are chosen at random without replacement.

Find the probability that the height of one child is greater than 160 cm and the height of the other is 150 cm or less.

Answer [2]

(c) Complete the histogram to represent the information in the table.



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[3]

Section B [48 marks]

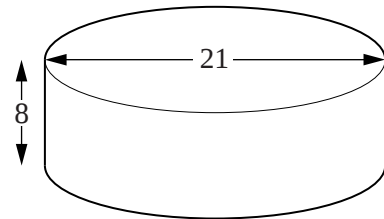
Answer **four** questions in this section.

Each question in this section carries 12 marks.

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margin

- 7 A cylindrical, **open** container has a diameter of 21 cm and height of 8 cm.

- (a) (i) Calculate the **total** external surface area of this container.



Answer cm^2 [3]

- (ii) A manufacturer receives an order for 30 000 containers.
He needs an extra 150 cm^2 of material for each container to cover wastage.

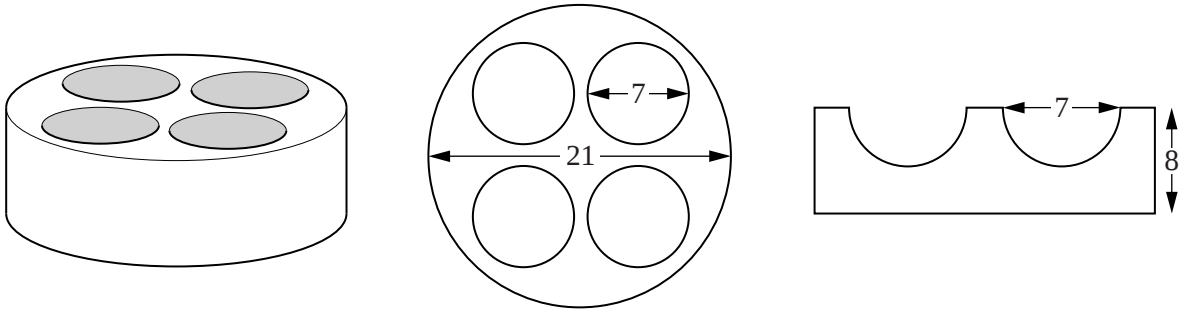
Calculate the area of material needed to make these containers.
Give your answer in square metres.

Answer m^2 [2]

[The Surface area of a sphere is $4\pi r^2$] [The Volume of a sphere is $\frac{4}{3}\pi r^3$]

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write in this
margin

- (b) A circular top that can hold 4 hemispherical bowls can be placed on the container.



Container and Top

Top

Cross-section

The top is a circle of diameter 21 cm with four circular holes of diameter 7 cm.
A hemispherical bowl of diameter 7 cm fits into each hole.
The cross-section shows two of these bowls.

- (i) Calculate the inside curved surface area of one of these hemispherical bowls.

Answer cm² [1]

- (ii) Calculate the total surface area of the top of the container, including the inside curved surface area of each bowl.

Answer cm² [3]

- (iii) With the top and the 4 bowls in place, calculate the volume of water required to fill the container.

Answercm³ [3]

- 8 The variables x and y are connected by the equation

$$y = 1 + 2x^2 - x^3.$$

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write in this
margin

The table below shows some values of x , and the corresponding values of y , correct to 1 decimal place where appropriate.

x	-1	-0.5	0	0.5	1	1.5	2	2.5
y	4	1.6	1	1.4	2	2.1	1	p

- (a) Calculate p .
Give your answer correct to 1 decimal place.

Answer $p = \dots\dots\dots$ [1]

- (b) On the graph paper opposite, using a scale of 2 cm to represent 1 unit on both axes, draw a horizontal x -axis for $-2 \leq x \leq 3$, and draw a vertical y -axis for $-3 \leq y \leq 5$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]

- (c) Use your graph to find all the solutions of $1 + 2x^2 - x^3 = 2$.

Answer $x = \dots\dots\dots$ [2]

- (d) By drawing a tangent, find the gradient of the curve at the point where $x = -0.5$.

Answer $\dots\dots\dots$ [2]

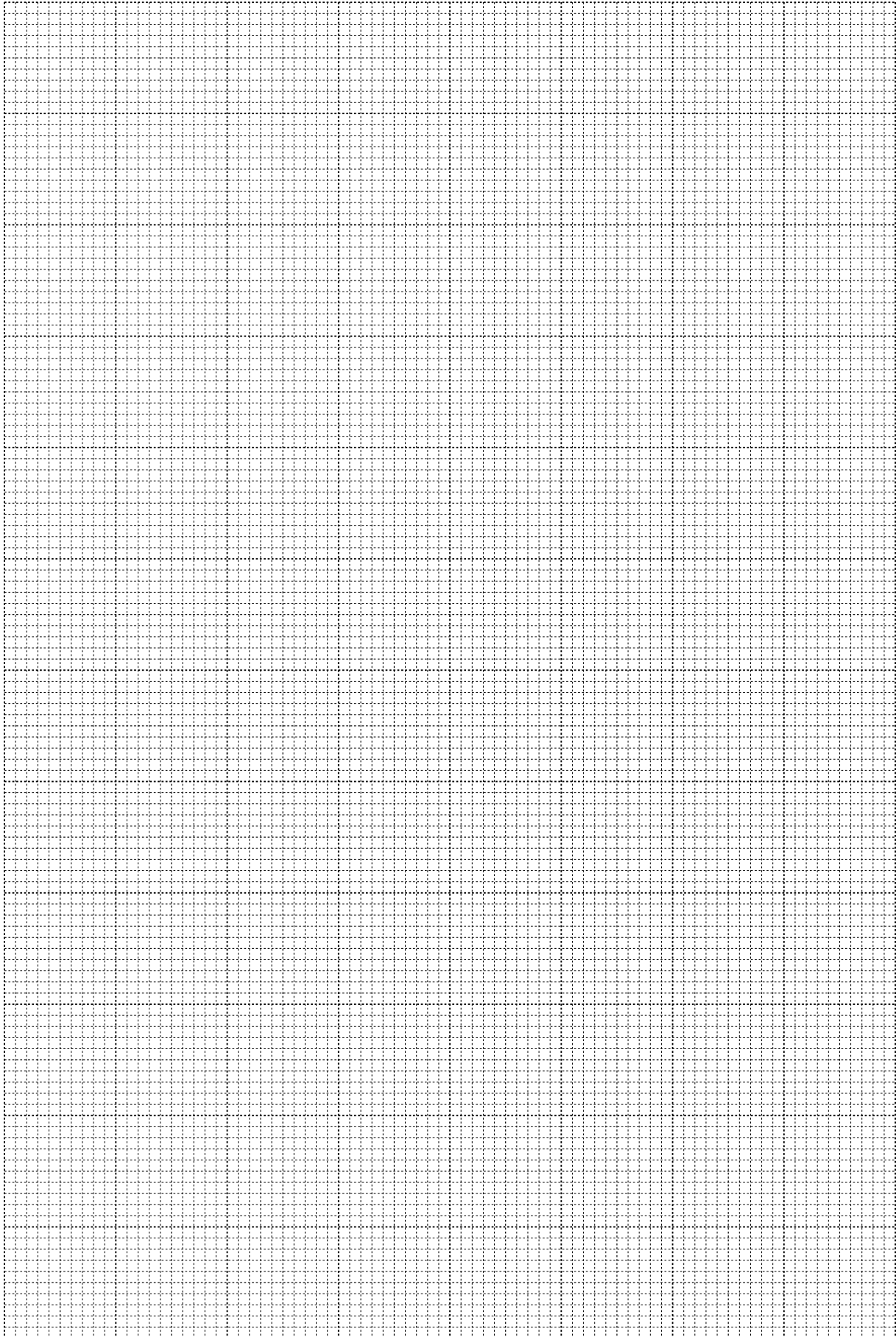
- (e) By drawing an appropriate straight line on the grid, solve the equation $1 + 2x^2 - x^3 = x$.

Answer $x = \dots\dots\dots$ [2]

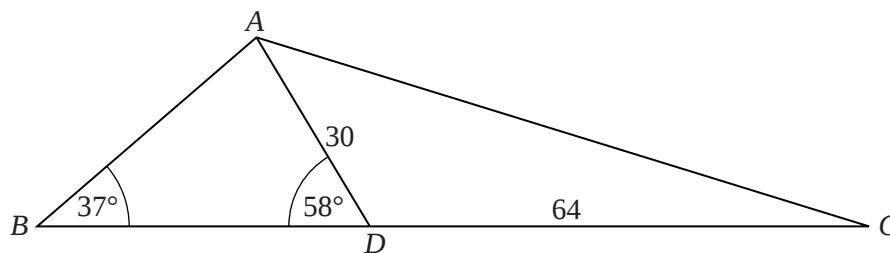
- (f) Find the range of values of k such that $1 + 2x^2 - x^3 = k$ has 3 solutions.

Answer $\dots\dots\dots$ [2]

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9

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margin

A , B , C and D are four points on level ground.

BDC is a straight line.

$AD = 30$ m and $DC = 64$ m.

$\hat{ABD} = 37^\circ$ and $\hat{ADB} = 58^\circ$.

(a) Calculate AB .

Answer m [3]

(b) Calculate AC .

Answer m [4]

- (c) Calculate the area of triangle ADC .

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Answer m^2 [2]

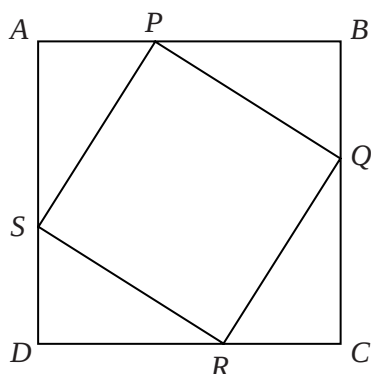
- (d) A vertical tower stands at A .

P is the point on the line BC such that the angle of depression from the top of the tower to the line BC is greatest.

Given that this angle of depression is 34° , calculate the height of the tower.

Answer m [3]

10

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margin

$ABCD$ is a square.
 $AP = BQ = CR = DS$.

- (a) Giving reasons, show that triangles PAS and QBP are congruent.

Answer

.....

.....

.....[3]

- (b) The length of a side of the square $ABCD$ is 40 cm and $AP = x$ cm.

- (i) Write down an expression for PB in terms of x .

Answer cm [1]

- (ii) Show that the area, $y \text{ cm}^2$, of $PQRS$ is given by $y = 1600 - 80x + 2x^2$.

[2]

- (c) (i) When $y = 1100$, show that $x^2 - 40x + 250 = 0$.

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[1]

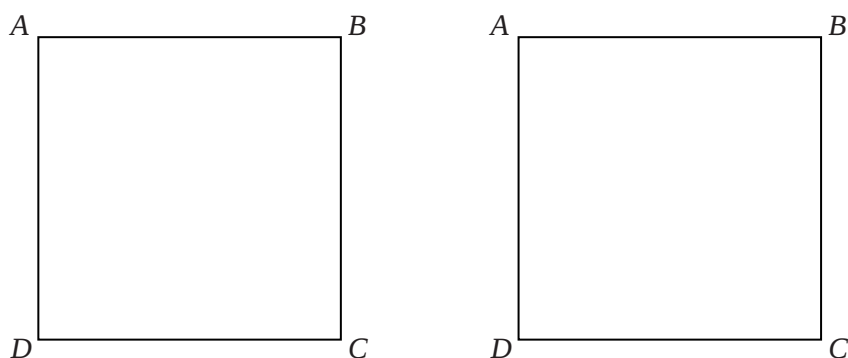
- (ii) Solve the equation $x^2 - 40x + 250 = 0$.
Give each answer correct to 1 decimal place.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (d) Two outlines of $ABCD$ are drawn to scale in the answer space below.
The scale is 1 : 10.

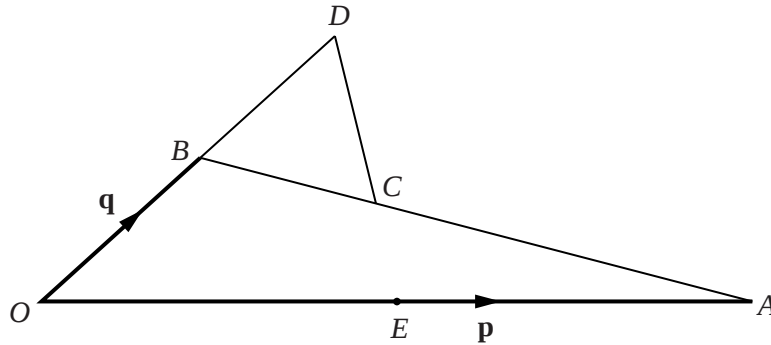
Draw accurately the quadrilateral $PQRS$ corresponding to each value of x found above.

Answer



[2]

11 (a)

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margin

B is the midpoint of OD and E is the midpoint of OA .

C is the point on AB such that $AC : CB = 2 : 1$.

$\vec{OA} = \mathbf{p}$ and $\vec{OB} = \mathbf{q}$.

(i) Find, in terms of $\mathbf{p}$ and $\mathbf{q}$,

(a) $\vec{AB}$,

Answer [1]

(b) $\vec{CD}$,

Answer [1]

(c) $\vec{ED}$.

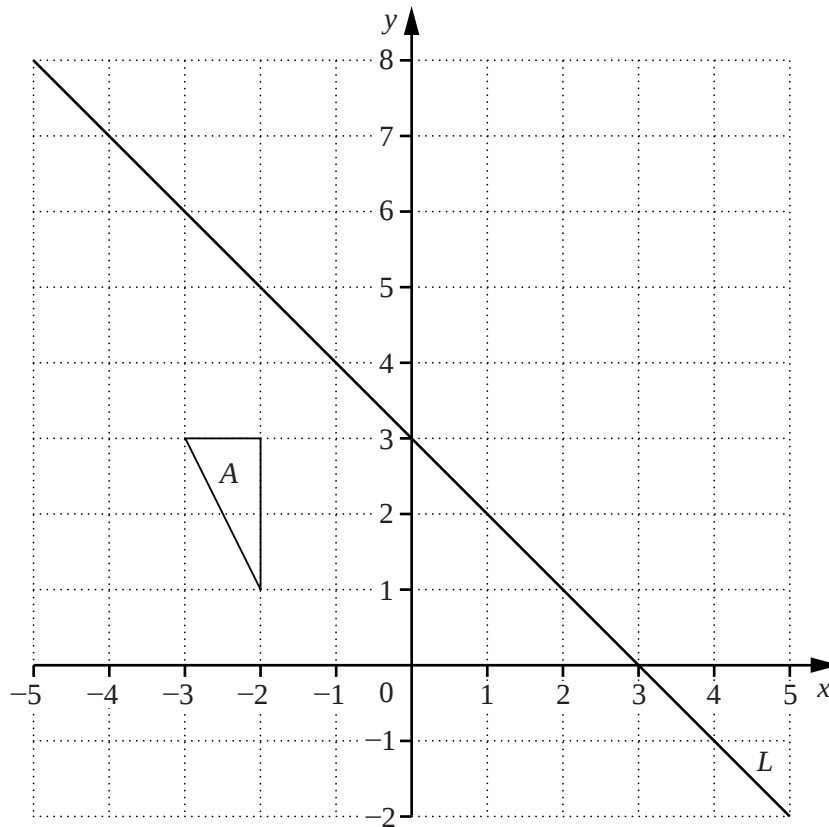
Answer [1]

(ii) Use your answers to parts (i)(b) and (i)(c) to make two statements about the points E , C and D .

Answer

..... [2]

(b)

Do not
write in this
margin

The diagram shows triangle *A* and line *L*.

- (i) Triangle *A* is mapped onto triangle *B* by a reflection in line *L*.

Draw and label triangle *B*.

[2]

- (ii) Triangle *A* is mapped onto triangle *C* by an anticlockwise rotation of 90° , centre $(0, 3)$.

Draw and label triangle *C*.

[2]

- (iii) Triangle *C* is mapped onto triangle *D* by a reflection in line *L*.

Describe the single transformation that maps triangle *B* onto triangle *D*.

Answer

..... [3]

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

October/November 2013

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **24** printed pages.



Section A [52 marks]

Answer **all** questions in this section.

For
Examiner's
Use

- 1 (a) The rate of exchange between dollars (\$) and pounds (£) is $\$1.56 = \text{£}1$.
The rate of exchange between euros (€) and pounds is $\text{€}1.10 = \text{£}1$.

- (i) Amy changes £300 into dollars.

Calculate how many dollars Amy receives.

Answer \$ [1]

- (ii) Ben changes €770 into pounds.

Calculate how many pounds Ben receives.

Answer £ [1]

- (iii) Chris changes \$780 into euros.

Calculate how many euros Chris receives.

Answer € [2]

- (b) Debbie changed some dollars into Japanese yen.
The rate of exchange was 81 dollars = 1 yen.

Emma changed the same number of dollars into yen.
The rate of exchange for Emma was 82 dollars = 1 yen.

Emma received 3 fewer yen than Debbie.

Given that the number of dollars changed each time is x , find x .

*For
Examiner's
Use*

Answer [3]

- 2 (a) Construct the triangle ABC in which $\hat{BAC} = 40^\circ$ and $AC = 8$ cm.

C is above the line AB , which is drawn for you.

For
Examiner's
Use

A ————— B

[2]

- (b) Construct the locus of all the points **outside** the triangle that are 2 cm from the perimeter of the triangle. [2]

- (c) Find and label the point P , **inside** the triangle, that is 6.5 cm from A and equidistant from B and C . [2]

3 The line AB joins the point $A(-2, 1)$ to the point $B(6, 5)$.

(a) Find the coordinates of the midpoint of AB .

Answer (.....,) [1]

(b) Find the gradient of AB .

Answer [1]

(c) AB intersects the y -axis at the point $(0, c)$.

Find c .

Answer [2]

(d) Express $\overrightarrow{AB}$ as a column vector.

Answer [1]

(e) C is the point $(5, 2)$ and D is the point (h, k) .
The lines AB and CD are equal in length and parallel.

Find the coordinates of each of the possible points D .

Answer (.....,) and (.....,) [3]

For
Examiner's
Use

- 4 The table shows the distribution of the masses of 100 babies at birth.

For
Examiner's
Use

Mass (x kg)	$1.5 < x \leq 2$	$2 < x \leq 2.5$	$2.5 < x \leq 3$	$3 < x \leq 3.5$	$3.5 < x \leq 4$	$4 < x \leq 4.5$	$4.5 < x \leq 5$
Number of babies	3	12	20	24	25	14	2

- (a) Write down the modal class.

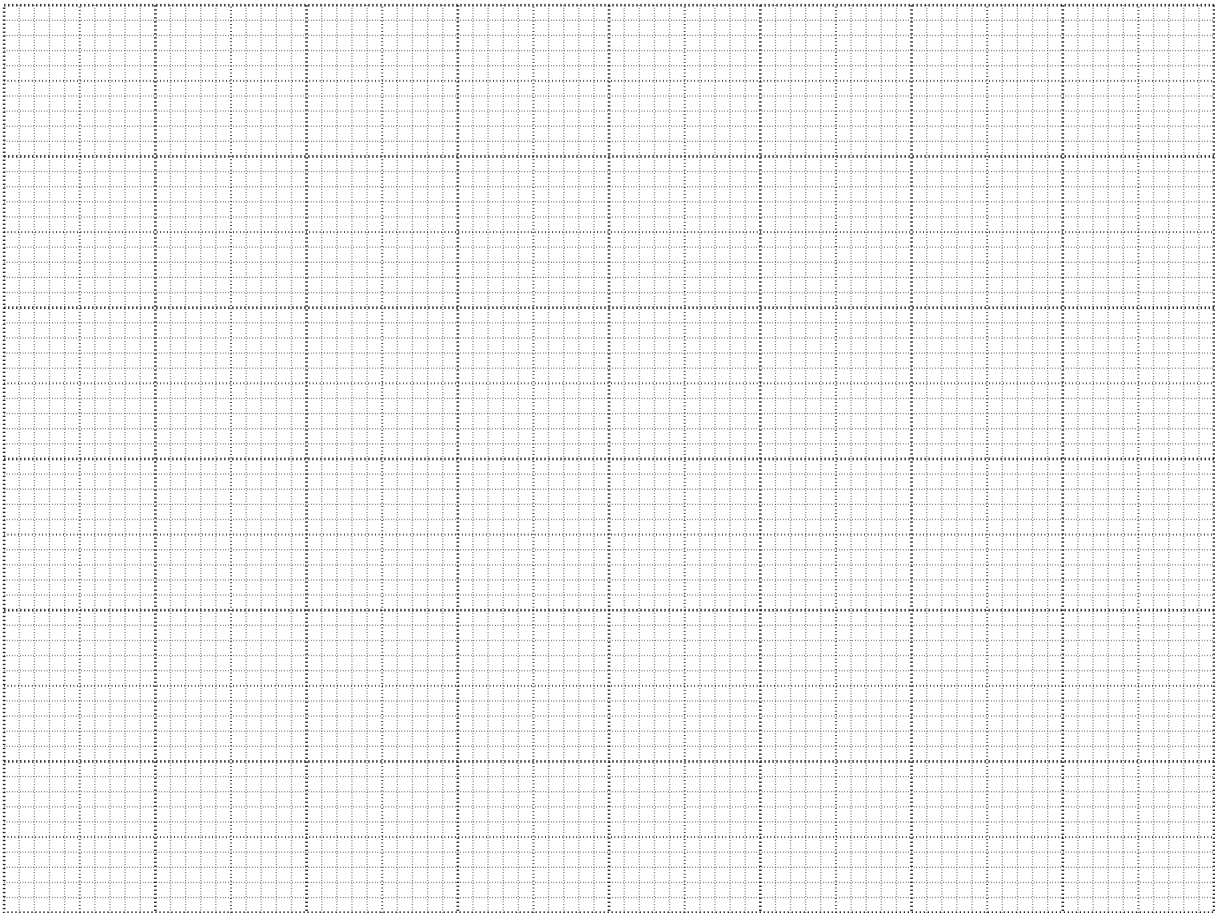
Answer [1]

- (b) For this part of the question use the grid below.

Using a scale of 4 cm to represent 1 kg, draw a horizontal x -axis for $1 \leq x \leq 5$.

Using a scale of 2 cm to represent 5 babies, draw a vertical axis for frequency from 0 to 30.

Using your axes, draw a frequency polygon to represent these results.



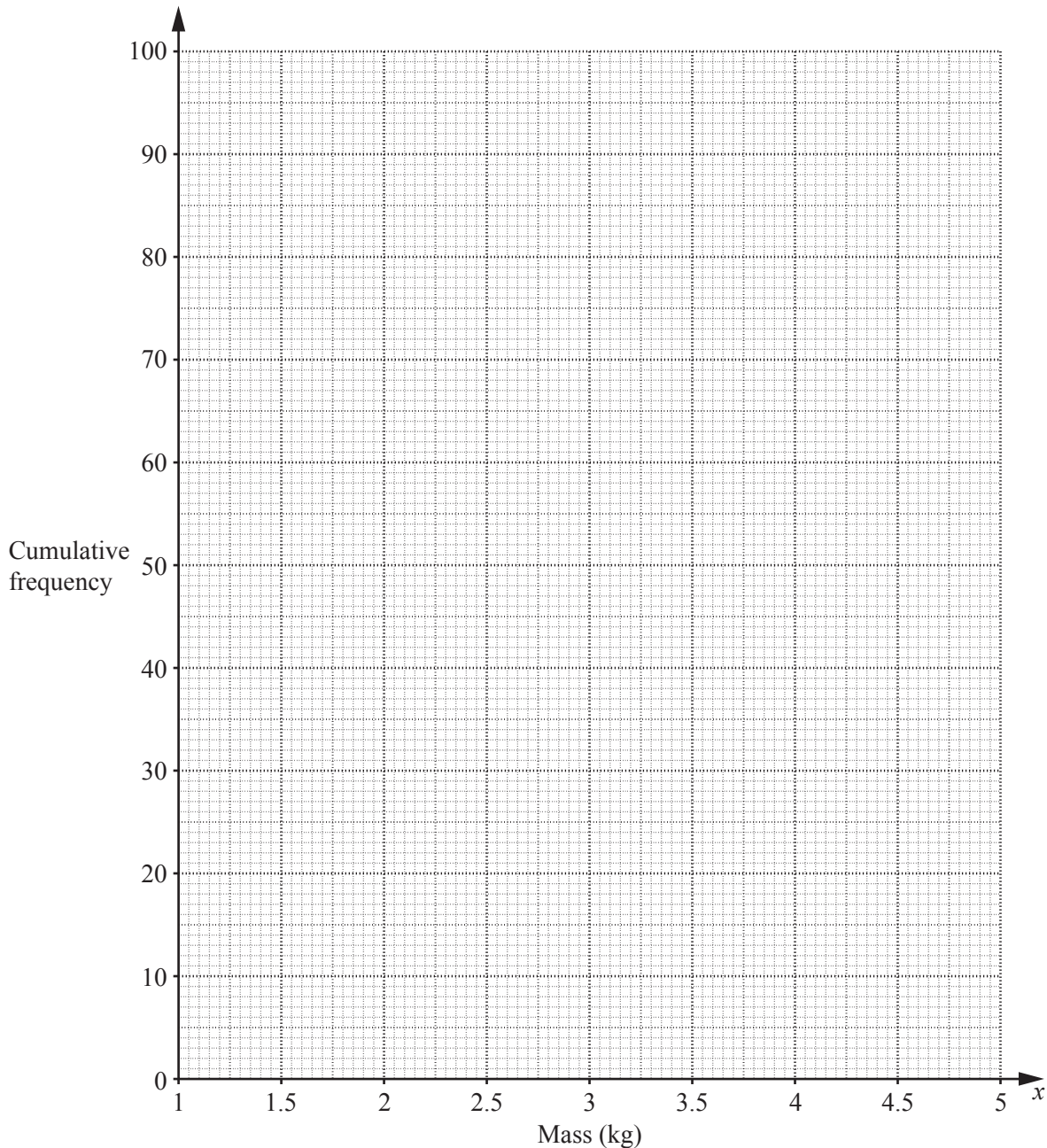
[2]

(c) (i) Complete the cumulative frequency table below.

Mass (x kg)	$x \leq 2$	$x \leq 2.5$	$x \leq 3$	$x \leq 3.5$	$x \leq 4$	$x \leq 4.5$	$x \leq 5$
Cumulative frequency	3	15					100

[1]

(ii) On the grid below draw a smooth cumulative frequency curve to represent these results.



[2]

(d) Use your curve to estimate

(i) the median mass,

Answer kg [1]

(ii) the 10th percentile.

Answer kg [1]

5 (a) Solve $\frac{2}{3-x} = 1$.

Answer [1]

(b) Factorise

(i) $5x + 5y$,

Answer [1]

(ii) $9x^2 - 16$.

Answer [1]

(c) (i) Factorise $2x^2 + 5x - 12$.

Answer [1]

(ii) Use your answer to **part (c)(i)** to solve the equation $2x^2 + 5x - 12 = 0$.

Answer $x =$ or [1]

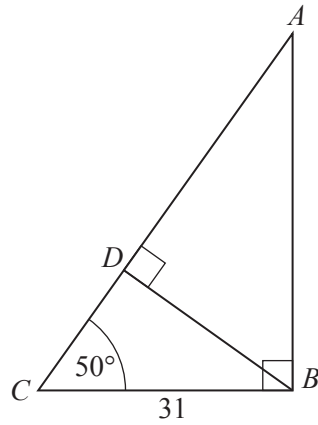
- (d) A source of light is observed from a distance of d metres.
The amount of light received, L units, is inversely proportional to the square of the distance.

*For
Examiner's
Use*

Given that $L = 9$ when $d = 2$, find the value of L when $d = 3$.

Answer [2]

6 (a)



In the triangle ABC , $\hat{ABC} = 90^\circ$, $\hat{ACB} = 50^\circ$ and $BC = 31$ m.
 D is the point on AC such that $\hat{BDA} = 90^\circ$.

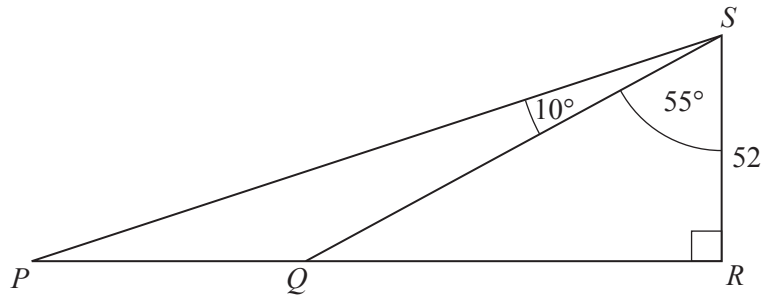
(i) Show that $CD = 19.93$ m, correct to 2 decimal places.

[2]

(ii) Calculate AD .

Answerm [3]

(b)

For
Examiner's
Use

Two boats are at the points P and Q .
 RS is a vertical cliff of height 52 m.
 $\angle PSQ = 10^\circ$ and $\angle QSR = 55^\circ$.

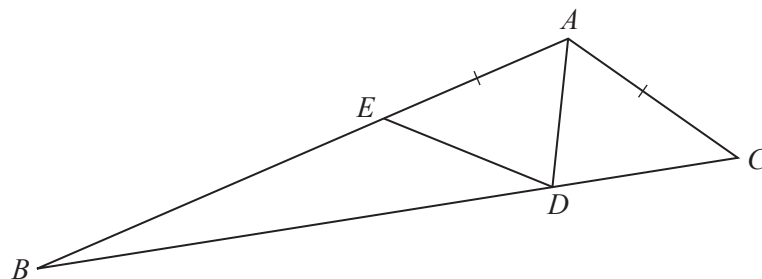
- (i) State the angle of depression of P from S .

Answer [1]

- (ii) Calculate the distance, PQ , between the boats.

Answerm [3]

7 (a)

For
Examiner's
Use

In triangle ABC , D is the point on BC such that AD bisects $\hat{BAC}$ and E is the point on AB such that $AE = AC$.

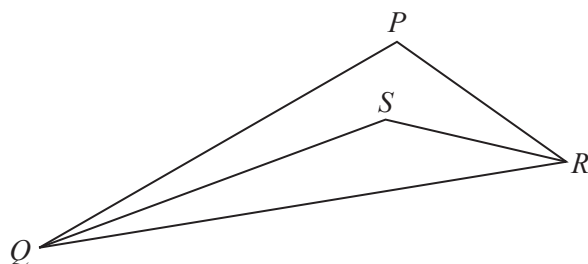
(i) Show that triangles AED and ACD are congruent.

[3]

(ii) Given that $\hat{ABD} = x^\circ$, $\hat{EDB} = y^\circ$ and $\hat{ACB} = z^\circ$, find x in terms of y and z .

Answer $x = \dots\dots\dots$ [2]

(b)

For
Examiner's
Use

In triangle PQR , QS bisects $\angle PQR$ and RS bisects $\angle PRQ$.
 $\angle PQR = 42^\circ$ and $\angle PRQ = 54^\circ$.

Find reflex angle QSR .

Answer [2]

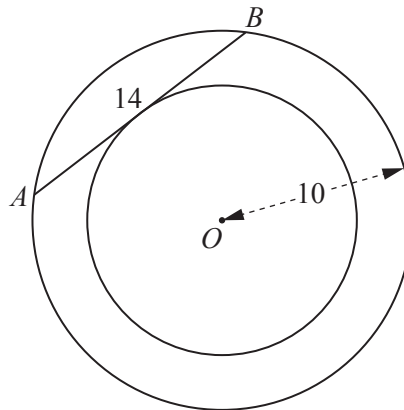
Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

For
Examiner's
Use

8 (a)

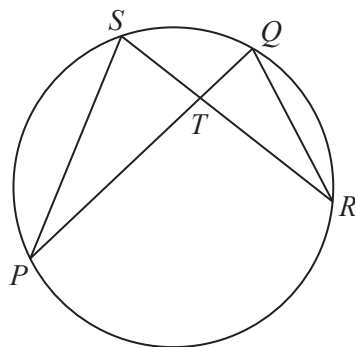


In the diagram, the circles each have centre O .
 AB is a chord of the larger circle and also a tangent to the smaller circle.
 $AB = 14$ cm and the radius of the larger circle is 10 cm.

Find the radius of the smaller circle.

Answer cm [3]

(b)

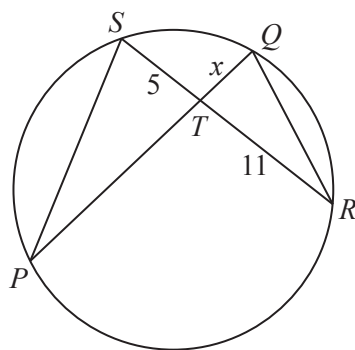


In the diagram, PQ and RS are chords of a circle that intersect at T .

(i) Show that triangles PST and RQT are similar.

[3]

(ii)



$ST = 5$ cm, $TR = 11$ cm and $TQ = x$ cm.

Given that $PQ = 18$ cm, show that x satisfies the equation

$$x^2 - 18x + 55 = 0.$$

[2]

- (iii) Solve the equation $x^2 - 18x + 55 = 0$.
Give each solution correct to 1 decimal place.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (iv) Find the difference between the lengths of PT and TQ .

Answer $\dots\dots\dots$ cm [1]

- 9 The number of bacteria in a colony **trebles** every hour.

The colony starts with 50 bacteria.

The table below shows the number of bacteria (y) in the colony after t hours.

Time (t hours)	0	1	2	2.5	3	3.5	4
Number of bacteria (y)	50	150	450	780	1350	2340	

- (a) Complete the table. [1]

- (b) On the grid on the opposite page plot the points in the table, and join them with a smooth curve. [3]

- (c) Use your graph to find the number of bacteria in the colony when $t = 3.2$.

Answer [1]

- (d) (i) By drawing a tangent, estimate the gradient of the curve when $t = 2.5$.

Answer [2]

- (ii) What does this gradient represent?

Answer [1]

- (e) Given that the equation of the graph is $y = ka^t$, find k and a .

Answer $k = \dots\dots\dots a = \dots\dots\dots$ [1]

- (f) The number of bacteria in another colony is given by the equation $y = 500 + 500t$.

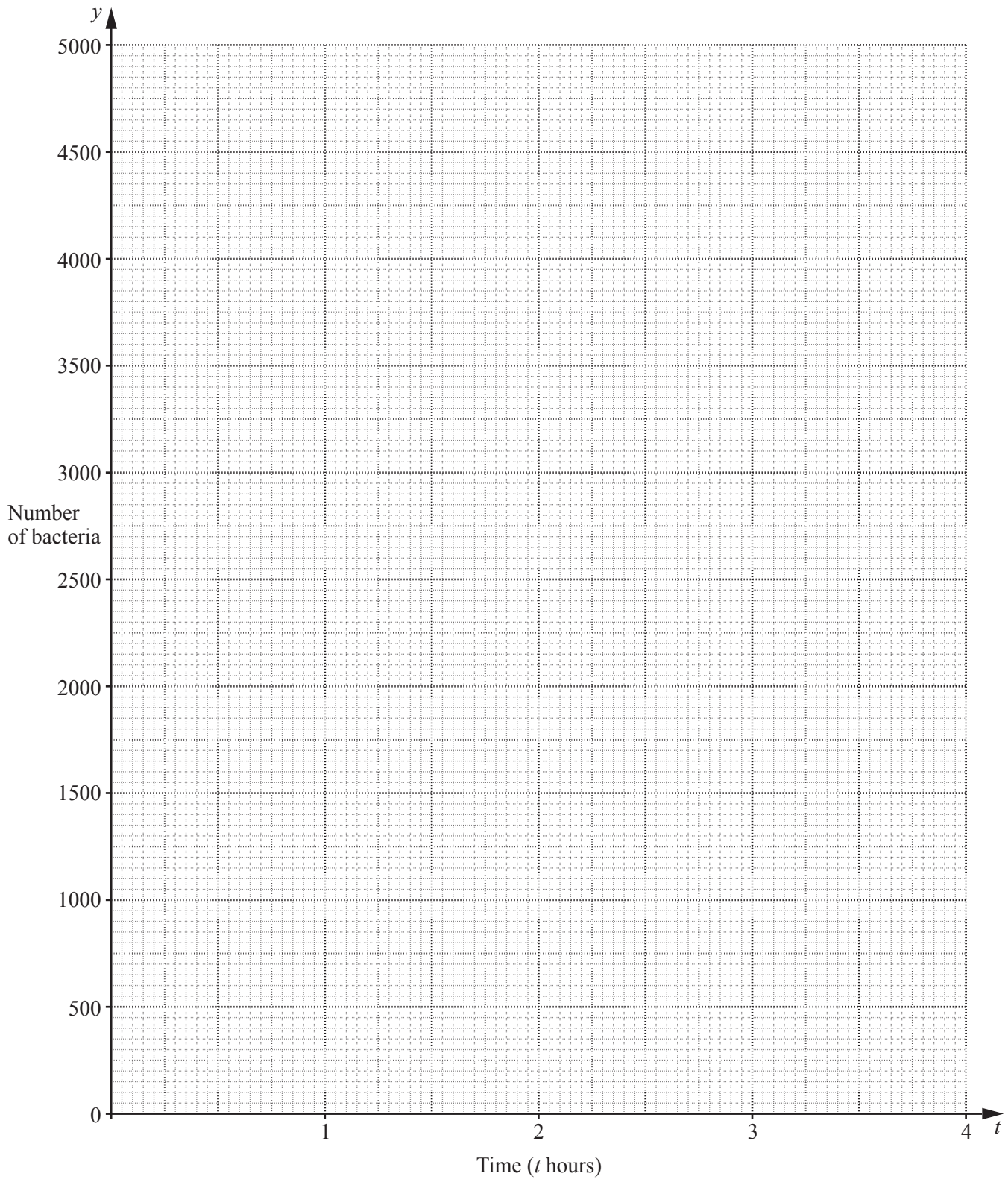
- (i) On the same axes, draw a graph to represent the number of bacteria in this colony.

[2]

- (ii) State the value of t when the number of bacteria in each colony is the same.

Answer [1]

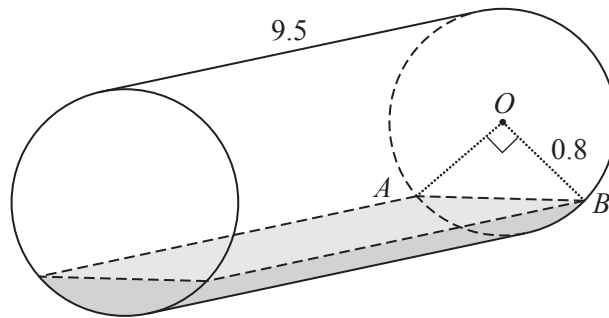
For
Examiner's
Use



10 A fuel tanker delivers fuel in a cylindrical container of length 9.5 m and radius 0.8 m.

For
Examiner's
Use

(a) After several deliveries, the fuel remaining in the container is shown in the diagram.



AB is horizontal, O is the centre of the circular cross-section and $\hat{AOB} = 90^\circ$.

(i) Calculate the curved surface area of the container that is in contact with the fuel.

Answer m^2 [2]

(ii) Calculate the volume of fuel remaining in the container.

Answer m^3 [4]

(iii) Calculate this volume remaining as a percentage of the volume of the whole container.

Answer % [2]

(b) The fuel is pumped through a cylindrical pipe of radius 4.5 cm at a rate of 300 cm/s.

(i) Calculate the volume pumped in 1 second.

For
Examiner's
Use

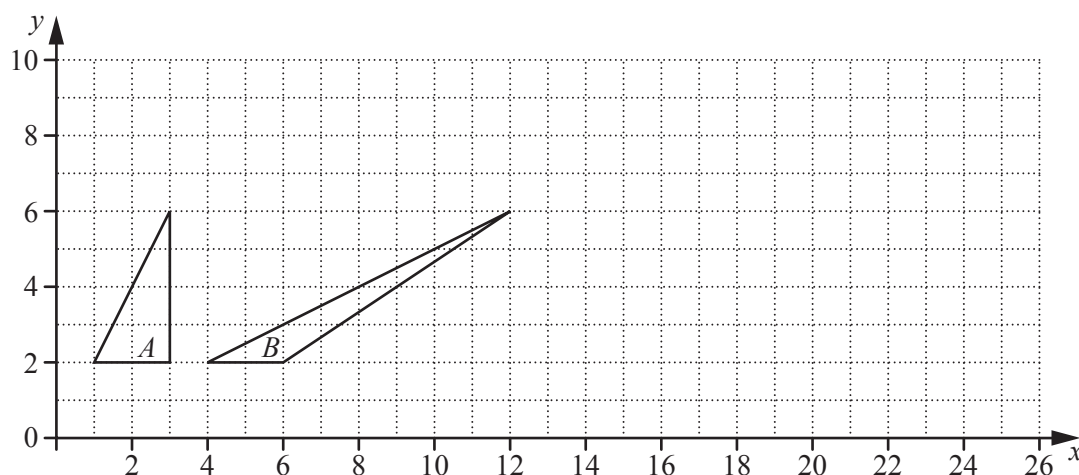
Answer cm³ [1]

(ii) Calculate the time taken, in minutes, to pump 25 000 litres of fuel.
Give your answer correct to the nearest minute.

Answer minutes [3]

- 11 The diagram shows triangles A and B .

For
Examiner's
Use



- (a) (i) Describe fully the **single** transformation that maps triangle A onto triangle B .

Answer
..... [2]

- (ii) Find the matrix that represents this transformation.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

- (b) Triangle B is mapped onto triangle C by the transformation represented by the matrix $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$.

- (i) On the grid above, draw and label triangle C . [2]

- (ii) Give the name of this transformation.

Answer [1]

- (iii) Find the matrix that represents the inverse transformation that maps triangle C onto triangle B .

For
Examiner's
Use

Answer $\left(\begin{array}{cc} & \\ & \end{array} \right)$ [2]

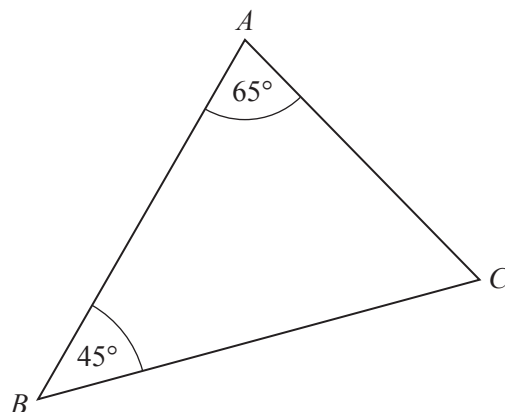
- (iv) Find the ratio area of triangle C : area of triangle B .

Answer : [1]

- (c) Find the matrix that represents the **single** transformation that maps triangle A onto triangle C .

Answer $\left(\begin{array}{cc} & \\ & \end{array} \right)$ [2]

12 (a)

For
Examiner's
Use

In triangle ABC , $\hat{ABC} = 45^\circ$ and $\hat{BAC} = 65^\circ$.
 AC is 5 cm shorter than BC .

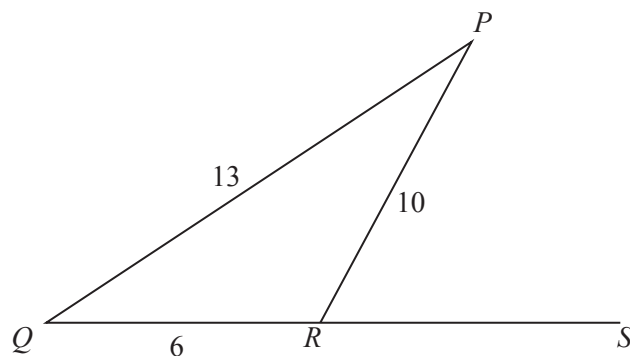
(i) Show that $BC = \frac{5 \sin 65}{\sin 65 - \sin 45}$.

[3]

(ii) Find the length of BC .

Answer cm [1]

(b)



In triangle PQR , $PQ = 13$ cm, $QR = 6$ cm and $RP = 10$ cm.
 QR is produced to S .

- (i) Find the value of $\cos \hat{P}RQ$, giving your answer as a fraction in its lowest terms.

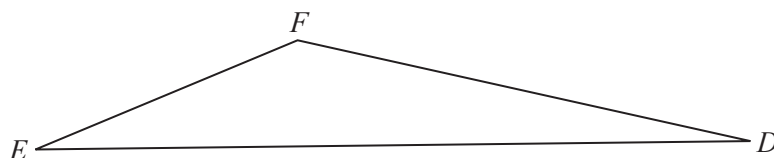
Answer [3]

- (ii) Hence write down the value of $\cos \hat{P}RS$.

Answer [1]

TURN OVER FOR THE REST OF THIS QUESTION

(c)



Triangle DEG has the same area as triangle DEF , but is not congruent to triangle DEF .
The point G is lower than DE and $GE = EF$.

Draw the triangle DEG in the diagram above.

[1]

(d) In triangle LMN , $\hat{LMN} = 30^\circ$ and $ML = 2MN$.

When the area of triangle LMN is 18 cm^2 , calculate MN .

Answer cm [3]

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

October/November 2013

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

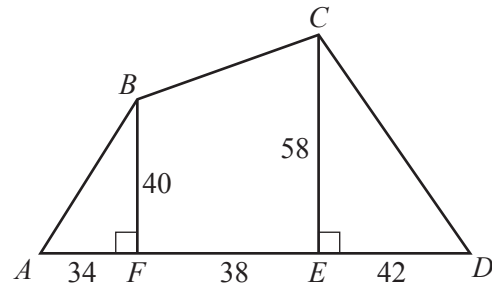
This document consists of **24** printed pages.



Section A [52 marks]

Answer **all** questions in this section.For
Examiner's
Use

1

 $ABCD$ is a level field. F and E are points on AD such that BF and CE are perpendicular to AD . $BF = 40$ m and $CE = 58$ m. $AF = 34$ m, $FE = 38$ m and $ED = 42$ m.

(a) Calculate the area of the field.

Answer m² [3]

(b) Calculate the length of BC .

For
Examiner's
Use

Answer m [2]

(c) Calculate $\hat{CDE}$.

Answer [2]

- 2 (a) The results of a survey of the number of cars owned by 50 families are given in the table below.

Number of cars	0	1	2	3
Number of families	4	35	6	5

For
Examiner's
Use

- (i) Calculate the mean number of cars per family.

Answer [2]

- (ii) When the same 50 families were surveyed at a later date, the results were as follows.

Number of cars	0	1	2	3
Number of families	x	37	y	5

The mean number of cars per family stayed the same as before.

Find x and y .

Answer $x =$

$y =$ [2]

- (b) A service station sells diesel, unleaded and super unleaded fuel. During one week, 13 500 litres of diesel and 36 000 litres of unleaded were sold. The total number of litres of fuel sold that week was 54 000.

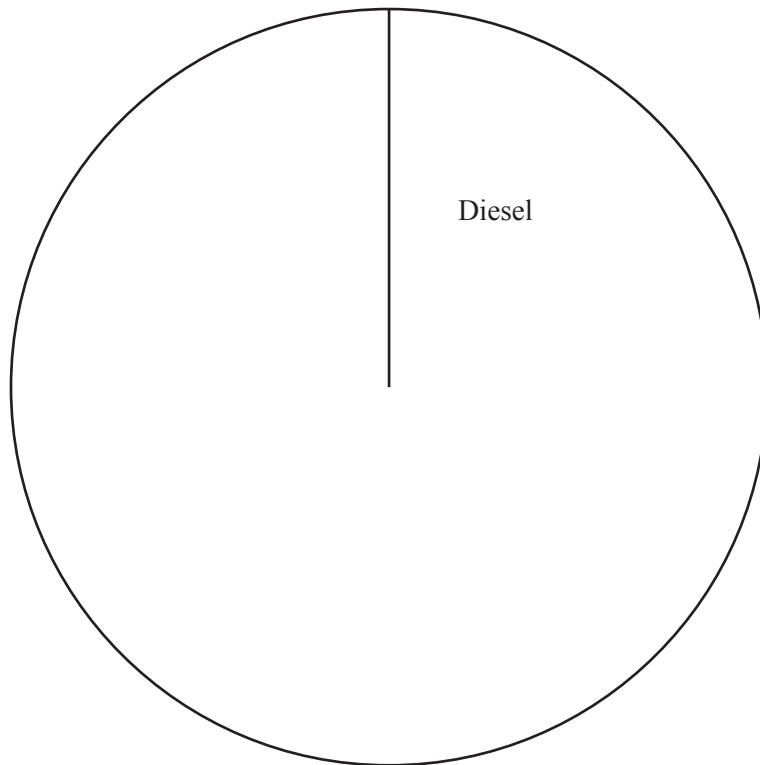
For
Examiner's
Use

- (i) What fraction of the total number of litres sold was super unleaded?
Give your answer in its lowest terms.

Answer [1]

- (ii) Complete the pie chart to represent the amounts of fuel sold.

Answer



[3]

- 3 (a) Find the value of $\frac{a + \sqrt{a^2 + b^2}}{a^2 - 2ab}$ when $a = -4$ and $b = -3$.

Give your answer as a fraction.

Answer[2]

- (b) Expand the brackets and simplify $(3x^2 - 1)(2x + 3) - x(9x - 2)$.

Answer[2]

- (c) (i) Factorise $9x^2 + 5x - 4$.

Answer[1]

- (ii) Use your answer to **part (c)(i)** to solve the equation $9x^2 + 5x - 4 = 0$.

For
Examiner's
Use

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [1]

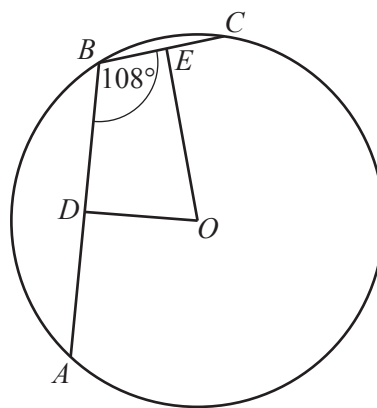
- (d) The sum of three consecutive integers is 84.

Find these three integers.

Answer $\dots\dots\dots, \dots\dots\dots, \dots\dots\dots$ [2]

- 4 (a) AB and BC are chords of a circle centre O .
 D is the midpoint of AB and E is the midpoint of BC .
 $\angle ABC = 108^\circ$.

Find $\angle DOE$ giving your reasons.

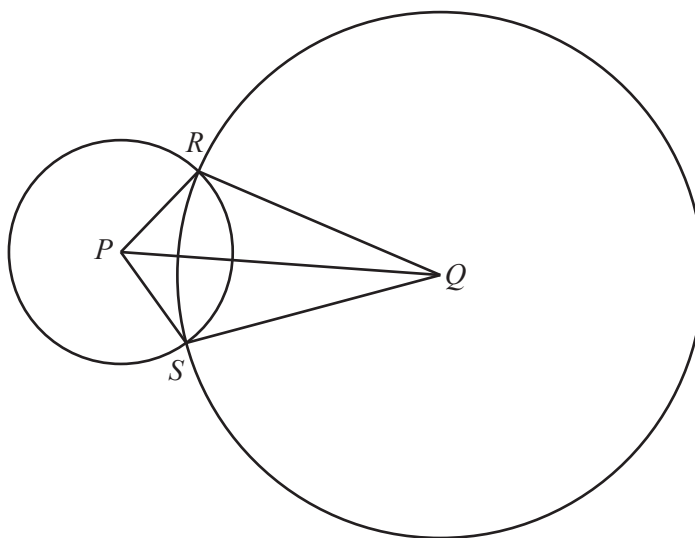


For
Examiner's
Use

Answer $\angle DOE = \dots\dots\dots$ because $\dots\dots\dots$

$\dots\dots\dots$ [2]

(b)

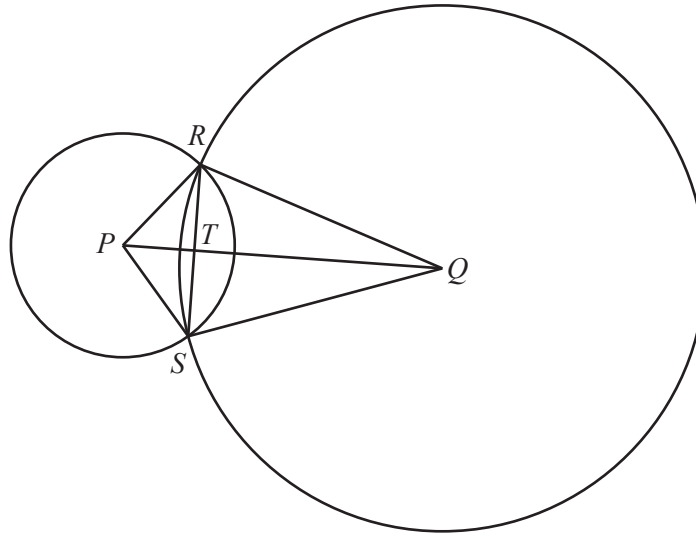


A circle centre P and a circle centre Q intersect at R and S .

- (i) Show that triangle PRQ is congruent to triangle PSQ .

[3]

(ii)

For
Examiner's
Use

RS and PQ intersect at T .

(a) State the name of the special quadrilateral $PRQS$.

Answer [1]

(b) Find $\hat{PTR}$.

Answer [1]

- 5 (a) $\mathcal{C} = \{x : x \text{ is an integer and } 2 \leq x \leq 12\}$
 $M = \{x : x \text{ is a multiple of } 3\}$
 $P = \{x : x \text{ is a prime number}\}$

(i) $a \in M \cap P$

Find a .

Answer [1]

- (ii) Find $(M \cup P)'$.

Answer [1]

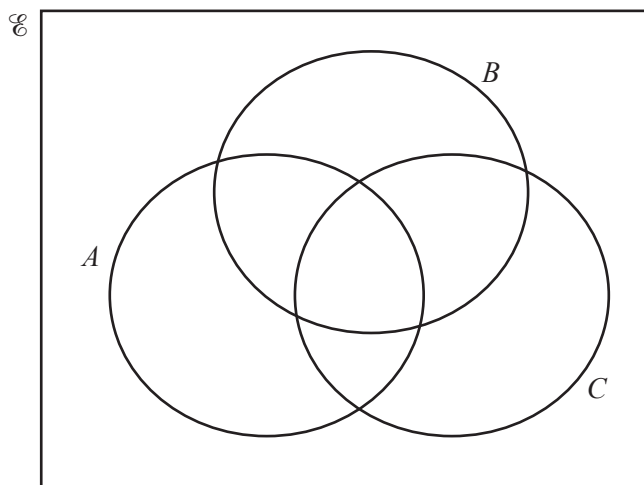
- (b) In a survey, 90 people were asked “Do you own a car?” and “Do you own a bicycle?”.
 A total of 27 people said they owned a bicycle.
 Of these, 13 owned **only** a bicycle.
 11 people owned neither a car nor a bicycle.

By drawing a Venn diagram, or otherwise, find how many people said that they owned a car.

Answer [2]

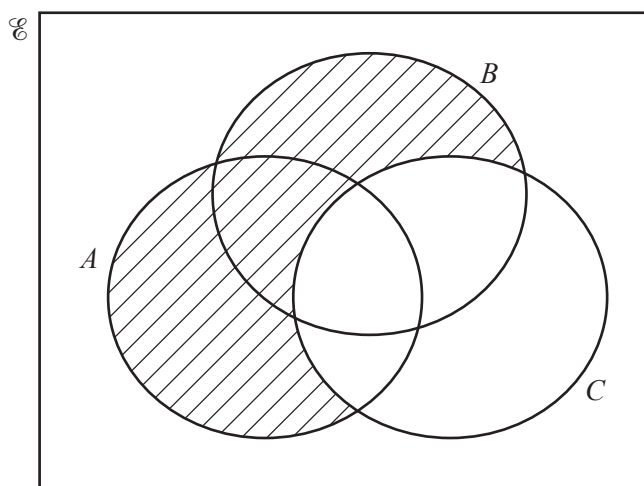
(c) The Venn diagrams show a Universal set, $\mathcal{U}$, and subsets A , B and C .

(i) Shade the set $(A \cup C)' \cap B$.



[1]

(ii) Express in set notation the subset shaded in this diagram.



Answer [1]

- 6 (a) (i) The cost price of bicycle A is \$620.
The shopkeeper sells it and makes a profit of 45%.

Calculate the selling price.

Answer \$..... [1]

- (ii) In a sale, the price of bicycle B is reduced from \$2400 to \$1596.

Calculate the percentage reduction given.

Answer% [2]

- (iii) Tax on the original price of bicycle C is charged at 20% of the original price.
After tax has been included, Matthew pays \$1080 for this bicycle.

Calculate the original price.

Answer \$..... [2]

- (b) Ada invests \$600 in an account that earns simple interest.
At the end of 3 years, the investment is worth \$681.

Calculate the rate of simple interest per year.

Answer% [3]

7 (a) Express as a single matrix $5\begin{pmatrix} 2 \\ -1 \\ 3 \end{pmatrix} - 4\begin{pmatrix} 1 \\ -3 \\ 0 \end{pmatrix}.$

Answer

[2]

(b) Express as a single matrix $\begin{pmatrix} 7 & -1 & 3 \\ 2 & 0 & 4 \end{pmatrix} \begin{pmatrix} 1 \\ 0 \\ 2 \end{pmatrix}.$

Answer

[2]

(c) $\mathbf{A} = \begin{pmatrix} 1 & 0 \\ -2 & 4 \end{pmatrix}$

(i) Find $\mathbf{A}^{-1}$.

Answer

$$\begin{pmatrix} & \\ & \end{pmatrix} [2]$$

(ii) $\mathbf{B} + 3\mathbf{I} = \mathbf{A}$ where $\mathbf{I}$ is the 2×2 identity matrix.

Find $\mathbf{B}$.*Answer*

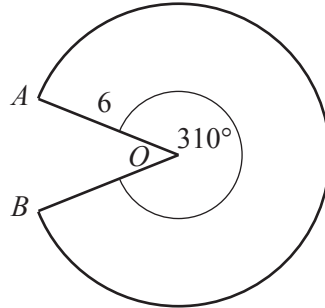
$$\begin{pmatrix} & \\ & \end{pmatrix} [2]$$

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

For
Examiner's
Use

8

The diagram shows a sector AOB of a circle with centre O and radius 6 cm.
The angle of the sector is 310° .

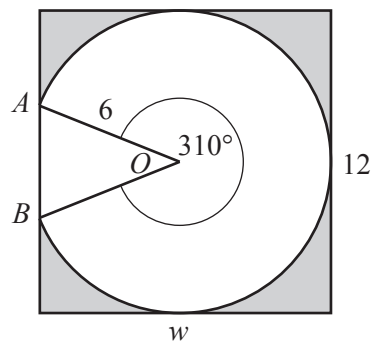
(a) Calculate the total perimeter of the sector.

Answer cm [3]

(b) Calculate the area of the sector.

Answer cm² [2]

- (c) This sector is cut from a rectangular piece of card of height 12 cm and width w cm.



One edge of the rectangular piece of card passes through A and B .
The other edges are tangents to the circle.

- (i) Calculate the value of w .

Answer [3]

- (ii) When the sector is cut out, the triangle AOB is retained.
The rest of the rectangular piece of card, shown shaded, is discarded as waste.

Calculate the percentage of the rectangular piece of card that is discarded as waste.

Answer% [4]

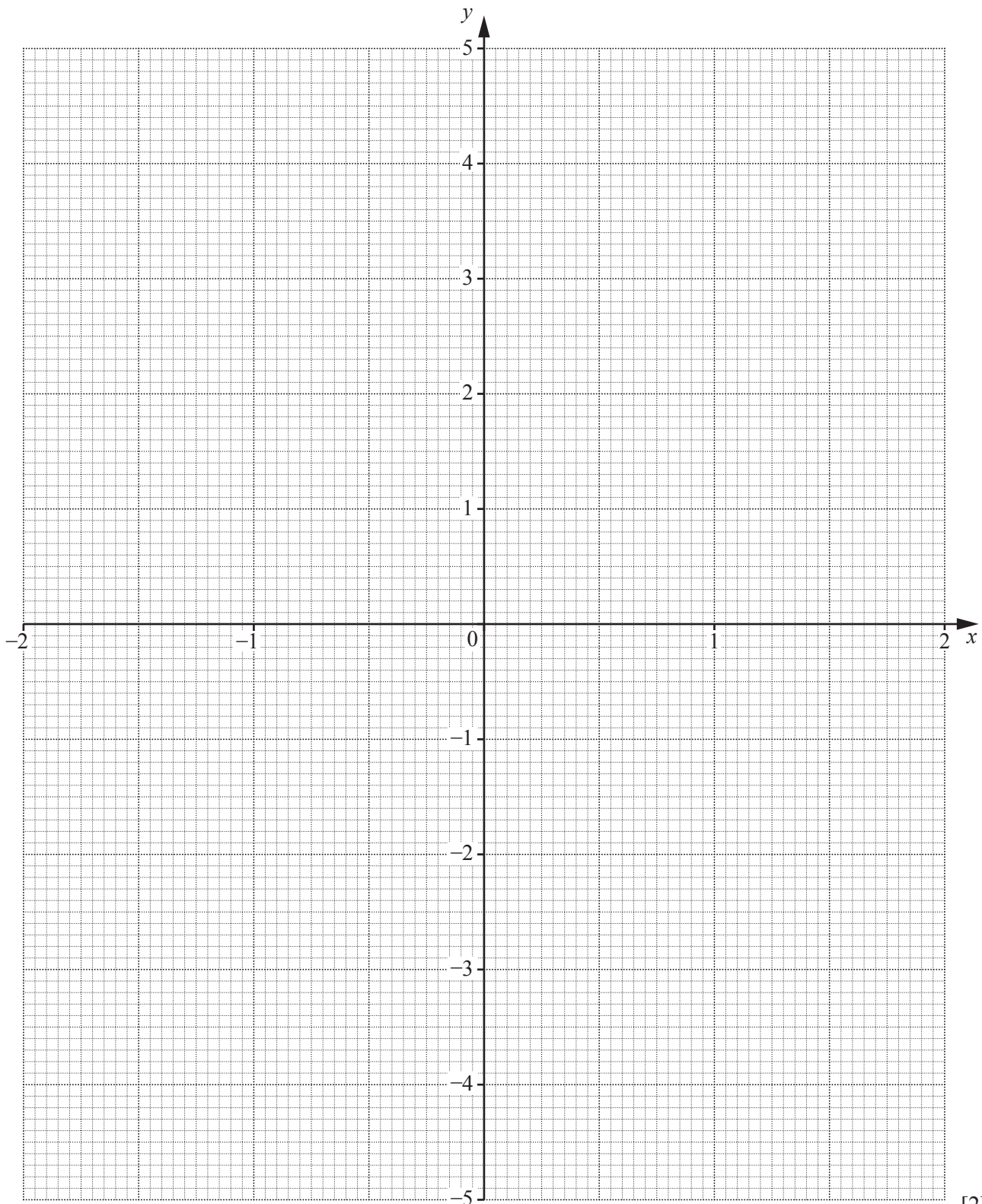
For
Examiner's
Use

- 9 The variables x and y are connected by the equation $y = x + \frac{1}{x}$.

The table below shows some values of x and the corresponding values of y .
The values of y are correct to 2 decimal places where appropriate.

x	0.25	0.5	0.75	1	1.25	1.5	1.75	2
y	4.25	2.5	2.08	2	2.05	2.17	2.32	2.5

- (a) On the grid, plot the points given in the table and join them with a smooth curve.



[2]

For
Examiner's
Use

- (b) By drawing a tangent, estimate the gradient of the curve when $x = 0.75$.

For
Examiner's
Use

Answer [2]

- (c) Let $f(x) = x + \frac{1}{x}$.

- (i) Given that $f(a) = b$, find $f(-a)$ in terms of b .

Answer [1]

- (ii) Hence, or otherwise, complete the table below for $y = x + \frac{1}{x}$.

x	-2	-1.75	-1.5	-1.25	-1	-0.75	-0.5	-0.25
y					-2			

[1]

- (iii) On the grid opposite, draw the graph of $y = x + \frac{1}{x}$ for $-2 \leq x \leq -0.25$. [1]

- (iv) Write down an estimate for the gradient of the curve when $x = -0.75$.

Answer [1]

- (d) (i) On the grid opposite, draw the graph of the straight line $y = 4 - x$. [1]

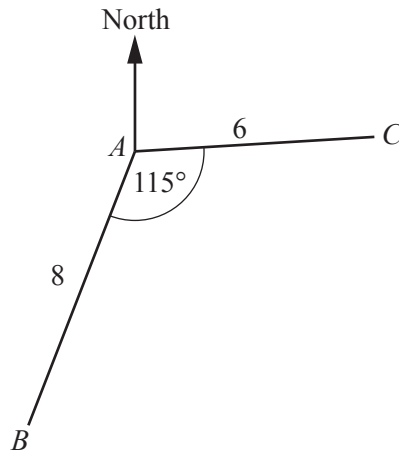
- (ii) Write down the x -coordinate of each of the points where the graphs of $y = 4 - x$ and $y = x + \frac{1}{x}$ intersect.

Answer $x = \dots\dots\dots$ and $\dots\dots\dots$ [1]

- (iii) Find the equation for which these x values are the solutions.
Give your equation in the form $Ax^2 + Bx + C = 0$.

Answer [2]

10 (a)



Two boats sail from A . One boat sails to B , and the other boat sails to C .
 $AB = 8$ km, $AC = 6$ km and $\hat{BAC} = 115^\circ$.

- (i) Calculate the distance, BC , between the boats.

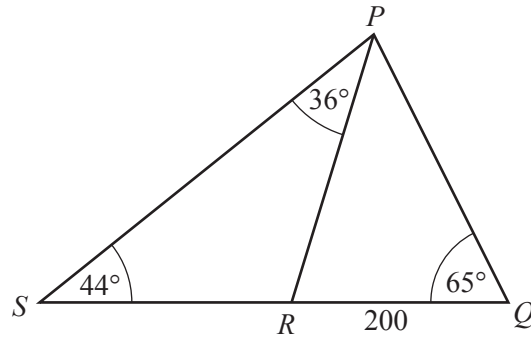
Answer km [4]

- (ii) The bearing of B from A is 200° .

Find the bearing of A from C .

Answer [2]

(b)



In triangle PQS , $\angle QPS = 36^\circ$ and $\angle QSP = 44^\circ$.

R is the point on QS such that $QR = 200$ m and $\angle RPS = 36^\circ$.

- (i) In triangle PQR , by using the sine rule, show that $PR = \frac{200 \sin 65}{\sin 35}$.

[2]

- (ii) Hence show that $SR = \frac{200 \sin 65 \sin 36}{\sin 35 \sin 44}$.

[2]

- (iii) Hence find the length of SR .

Answer m [1]

- (iv) Hence evaluate $\frac{\text{area of triangle } SPQ}{\text{area of triangle } PQR}$.

Answer [1]

- 11 (a) Express as a single fraction, in its simplest form, $\frac{7}{p+2} - \frac{4}{2p-3}$.

Answer [3]

- (b) The distance between London and York is 320 km .
A train takes x hours to travel between London and York.

- (i) Write down an expression, in terms of x , for the average speed of the train.

Answer km/h [1]

- (ii) A car takes $2\frac{1}{2}$ hours longer than a train to travel between London and York.
The average speed of the train is 80 km/h greater than the average speed of the car.

Form an equation in x and show that it simplifies to $2x^2 + 5x - 20 = 0$.

[3]

- (iii) Solve the equation $2x^2 + 5x - 20 = 0$, giving your answers correct to 2 decimal places.

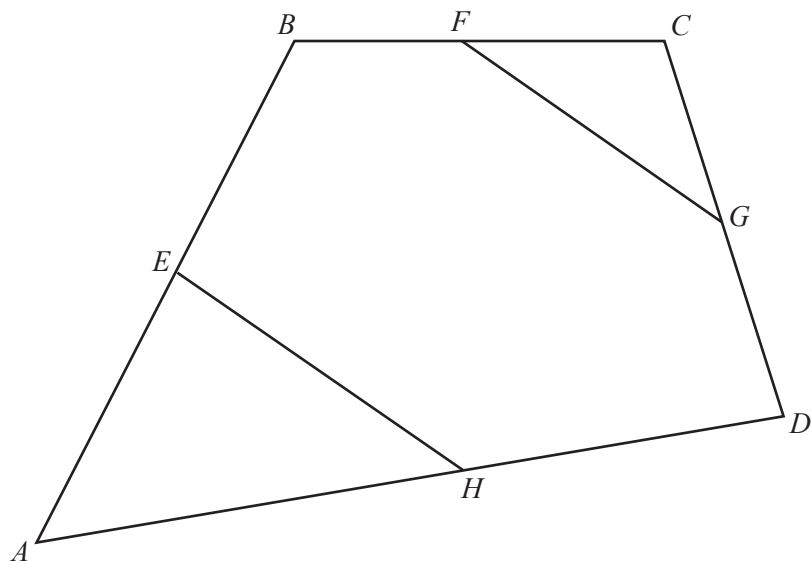
For
Examiner's
Use

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (iv) Hence find the average speed of the car correct to the nearest km/h.

Answer $\dots\dots\dots$ km/h [2]

12 (a)

For
Examiner's
Use

(i) $\overrightarrow{AD} = \begin{pmatrix} 6 \\ 1 \end{pmatrix}$

Calculate $|\overrightarrow{AD}|$.

Answer [1]

(ii) $\overrightarrow{AE} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$

H is the midpoint of AD .

Find $\overrightarrow{EH}$.

Answer $\begin{pmatrix} \\ \end{pmatrix}$ [2]

(iii) $\overrightarrow{BF} = \begin{pmatrix} 1.5 \\ 0 \end{pmatrix}$ $\overrightarrow{CG} = \begin{pmatrix} 0.5 \\ -1.5 \end{pmatrix}$

F is the midpoint of BC .

Find $\overrightarrow{FG}$.

For
Examiner's
Use

Answer $\begin{pmatrix} \\ \end{pmatrix}$ [1]

(iv) Use your answers to **parts (ii) and (iii)** to complete the following statement.

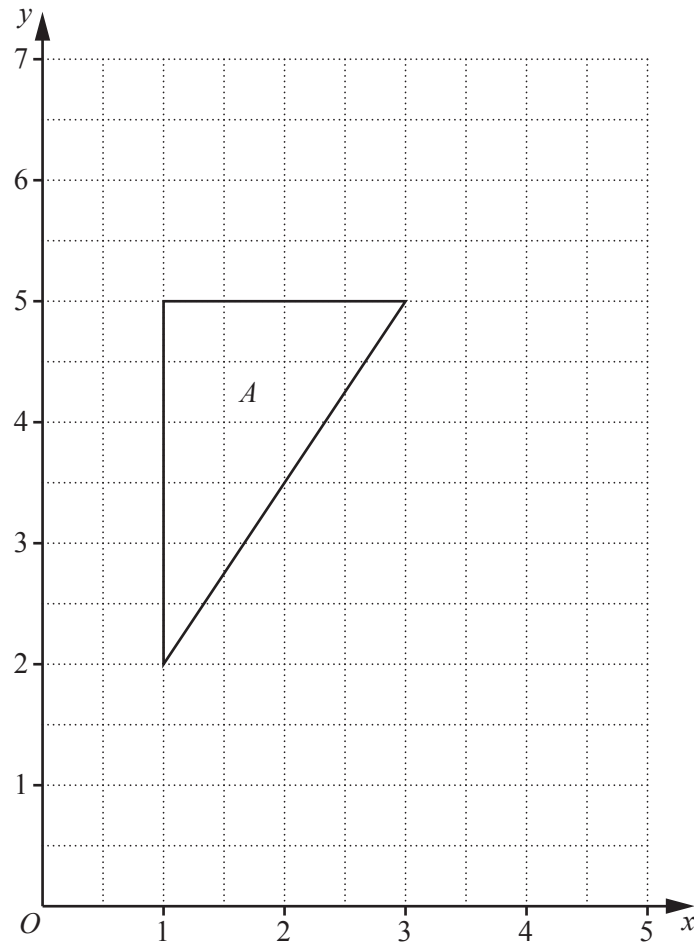
The lines EH and FG are and [1]

(v) Given that E is the midpoint of AB , show that G is the midpoint of CD .

[2]

TURN OVER FOR THE REST OF THIS QUESTION

(b)



Triangle A has vertices $(1, 2)$, $(1, 5)$ and $(3, 5)$.

- (i) An enlargement, centre $(1, 2)$, scale factor 1.5 , maps triangle A onto triangle B .

Draw triangle B .

[2]

- (ii) An enlargement, centre $(1, 2)$, scale factor -0.5 , maps triangle A onto triangle C .

Draw triangle C .

[2]

- (iii) Find the ratio area of triangle C : area of triangle B .

Answer : [1]

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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

October/November 2014

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **23** printed pages and **1** blank page.

Section A [52 marks]

Answer **all** questions in this section.

- 1 (a) The table shows some of the nutritional information for a 300 g tin of soup.

Carbohydrate	18 g
Fat	20.1 g
Fibre	0.6 g
Sodium	1.38 g

- (i) What percentage of the 300 g tin of soup is carbohydrate?

Answer % [1]

- (ii) What fraction of the 300 g tin of soup is fibre?
Give your answer as a fraction in its lowest terms.

Answer [1]

- (iii) Of the carbohydrates, 15% are sugars.
How many grams of sugars are in one tin of soup?

Answer g [1]

- (b) I need 2500 g of soup.

How many 300 g tins of soup do I need to buy?

Answer [1]

(c) During March there is a special promotion and the soup is on sale in tins containing 20% extra.

(i) These tins of soup each contain 4.2 g of protein.

How much protein was contained in each original 300 g tin of soup?

Answer g [2]

(ii) The special promotion tins cost \$0.80 .

The soup can also be bought in larger tins containing 500 g for \$1.12 .

Is it better value to buy the 500 g tin or the special promotion tin?

Show your working.

[2]

- 2 Hendrik travels by plane from London to Bangkok.
When it is 04 00 local time in London it is 10 00 local time in Bangkok.

(a) The flight takes 11 hours and 15 minutes.

If he leaves London at 21 50 local time, what is the local time in Bangkok when he arrives?

Answer [2]

- (b) On his return journey, Hendrik leaves Bangkok at 07 45 local time and arrives back in London on the same day at 13 40 local time.

How long was his return flight?

Answer hours minutes [2]

- (c) The graph opposite shows the exchange rate between British Pounds (£) and Thai Baht (THB) on the day Hendrik arrives in Bangkok.

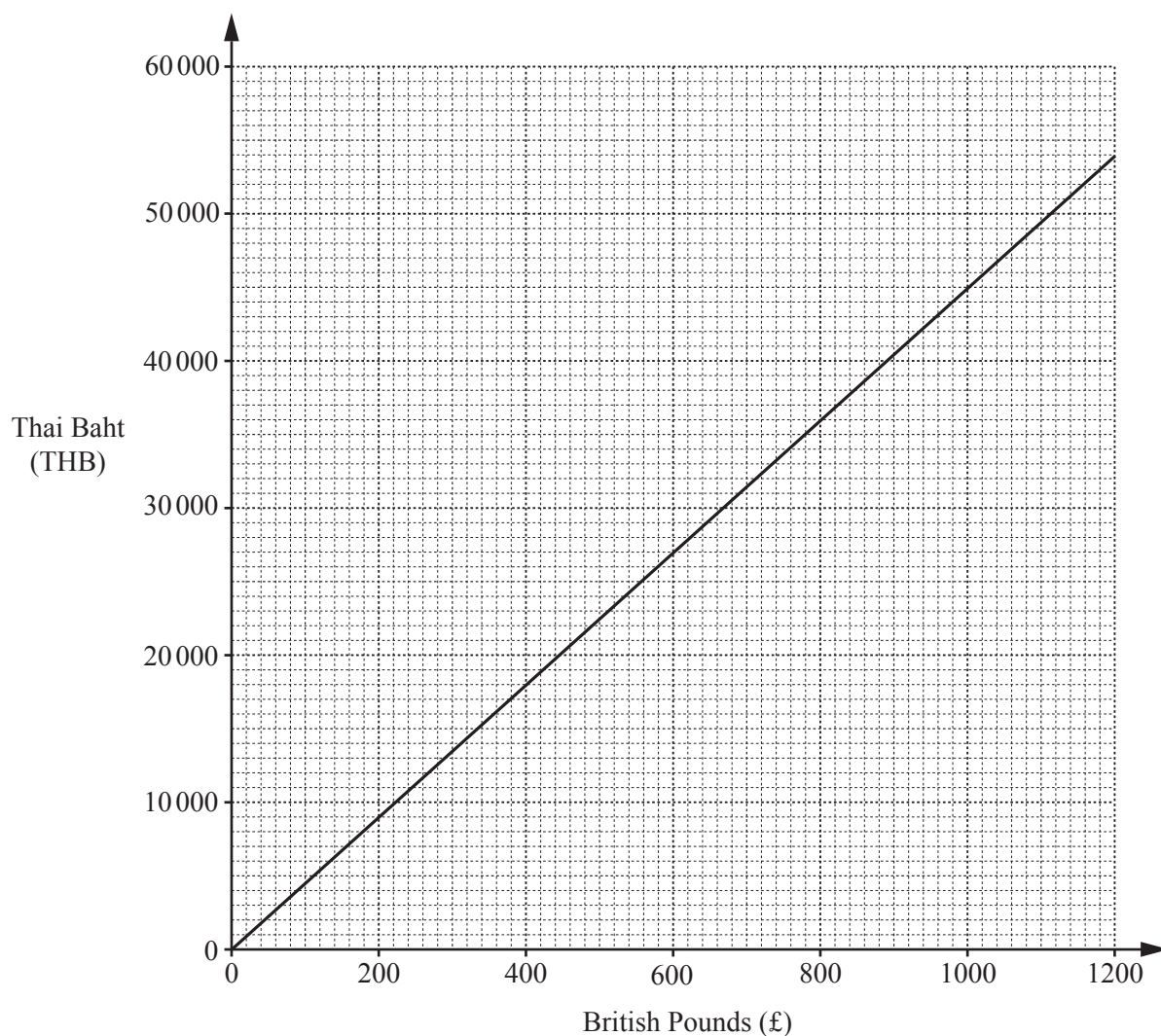
(i) Use the graph to estimate the cost in British Pounds of an item costing 13 000 THB.

Answer £ [1]

(ii) The exchange rate can be written as £1 = k THB.

Find k .

Answer [1]



- (d) The cost of flights from London to Bangkok is shown in the table below.
 For this cost, passengers are allowed to take luggage up to the weight shown.
 Passengers taking more than this weight of luggage pay an excess charge at the rate shown.

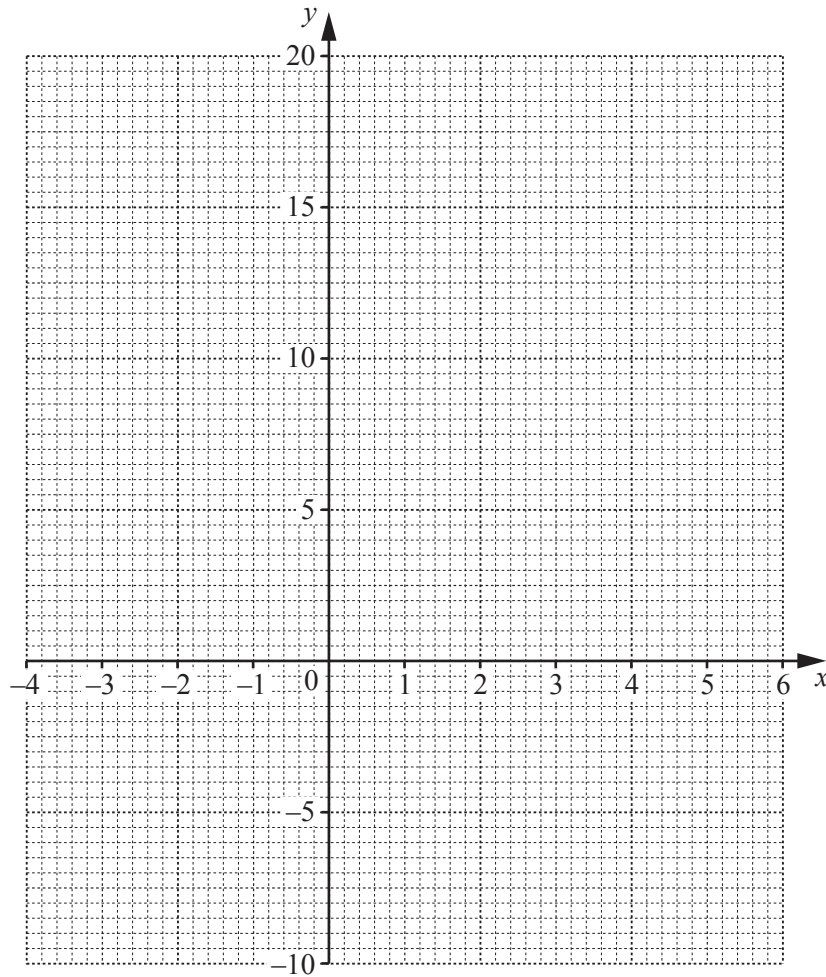
	Cost of flight	Weight of luggage included	Charge per extra 1 kg
Business Class	£1932	30 kg	£24
Economy Class	£683	23 kg	£24

Calculate the total cost of Hendrik flying Economy Class from London to Bangkok with luggage weighing 29 kg.

Answer £ [2]

- 3 (a) (i) Complete the table and hence draw the graph of $y = x^2 - 2x - 8$.

x	-4	-3	-2	-1	0	1	2	3	4	5	6
y		7	0	-5	-8	-9	-8	-5	0	7	



[3]

- (ii) Use your graph to solve $x^2 - 2x - 8 = 2$.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [2]

- (iii) By drawing a tangent, estimate the gradient of the curve at $(3, -5)$.

Answer $\dots\dots\dots$ [2]

- (b) Solve algebraically $x^2 + x - 9 = 0$, giving your answers correct to 2 decimal places.

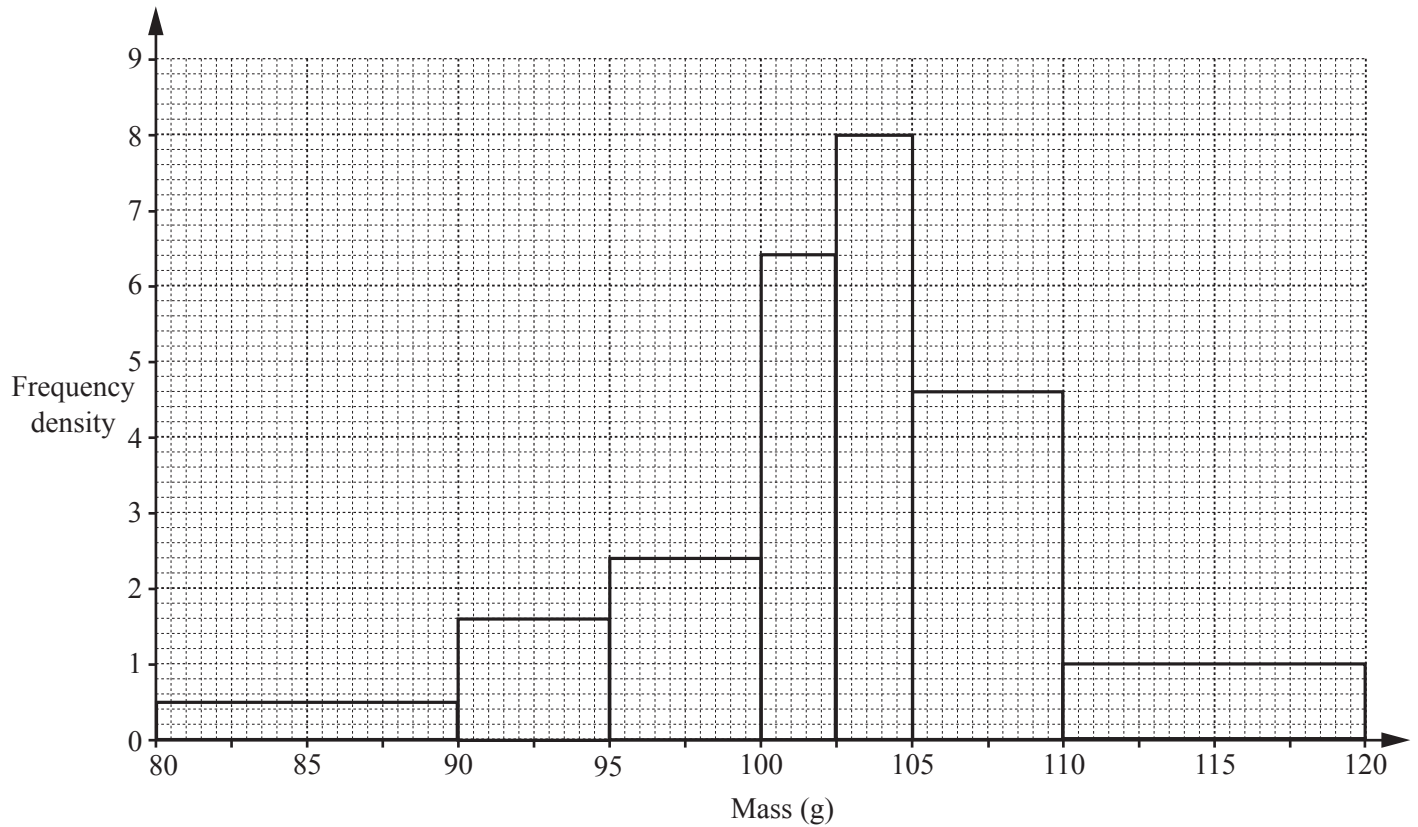
Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (c) The x -coordinates of the intersection of the line L and the curve $y = x^2 - 2x - 8$ are the solutions of the equation $x^2 + x - 9 = 0$.

Find the equation of the line L .

Answer $\dots\dots\dots$ [2]

- 4 (a) The histogram represents the distribution of the masses, in grams, of individual apples in a box.



This information is summarised in the table below.

Mass (m g)	Frequency
80 < m ≤ 90	5
90 < m ≤ 95	8
95 < m ≤ 100	p
100 < m ≤ 102.5	q
102.5 < m ≤ 105	20
105 < m ≤ 110	23
110 < m ≤ 120	10

Calculate p and q .

Answer $p = \dots\dots\dots q = \dots\dots\dots$ [2]

- (b) The mass of each plum in a box is recorded correct to the nearest 5 grams.

Mass (to the nearest 5 g)	Frequency
10 – 15	6
20 – 25	18
30 – 35	25
40 – 45	10
50 – 55	1

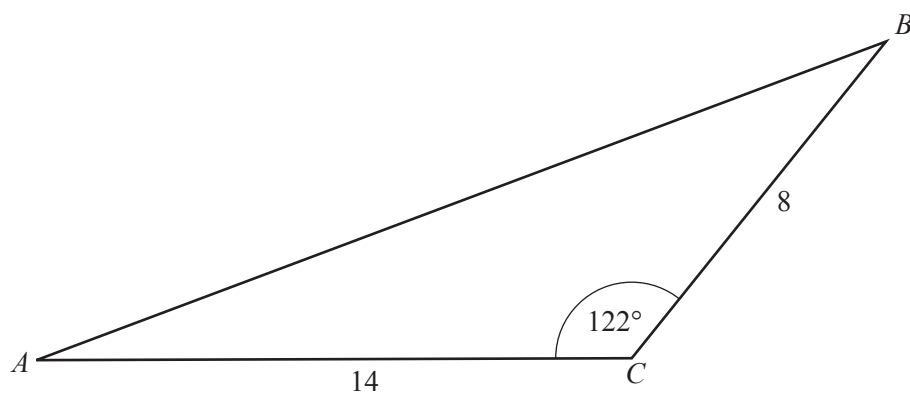
- (i) Calculate an estimate of the mean mass of a plum.

Answer g [3]

- (ii) Calculate the upper bound for the total mass of plums in the box.

Answer g [2]

5



In triangle ABC , $AC = 14$ cm, $BC = 8$ cm and $\hat{ACB} = 122^\circ$.

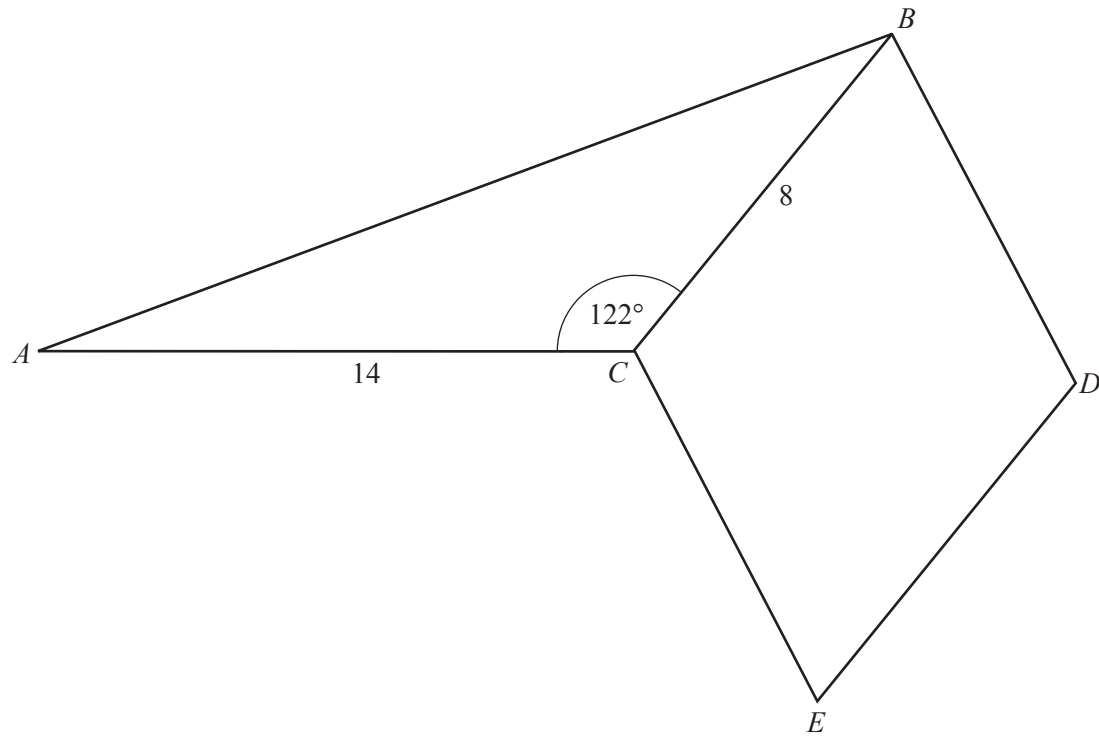
(a) Show that $AB = 19.5$ cm, correct to 3 significant figures.

[4]

(b) Calculate $\hat{ABC}$.

Answer [3]

- (c) A rhombus, $BDEC$, of area 52 cm^2 and sides 8 cm is placed next to triangle ABC as shown in the diagram.



Given that $\angle BCE$ is an obtuse angle, calculate the **reflex** angle $\angle ACE$.

Answer [4]

6

$$f(x) = 2x - 7$$

(a) Calculate $f(3)$.

Answer $f(3) = \dots\dots\dots$ [1]

(b) Find $f^{-1}(x)$.

Answer $f^{-1}(x) = \dots\dots\dots$ [2]

(c) Find the value of g given that $f(3g) = g + 4$.

Answer $g = \dots\dots\dots$ [3]

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SECTION B STARTS ON THE NEXT PAGE

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

7 (a) Solve

(i) $\frac{4x}{3} = 1$,

Answer $x = \dots\dots\dots$ [1]

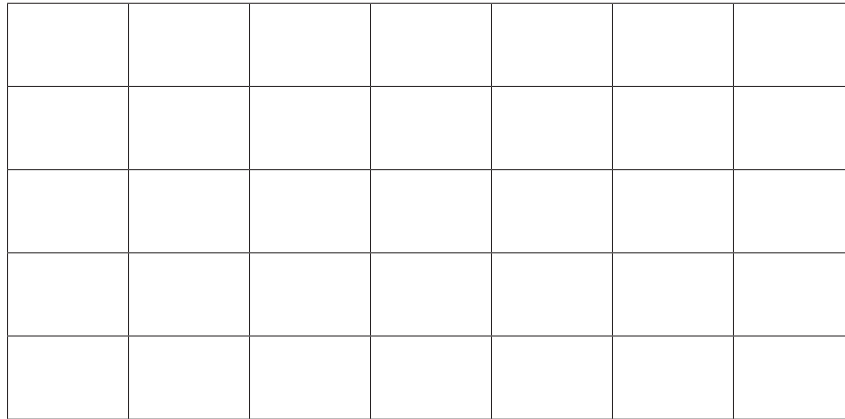
(ii) $4y - 3(2y + 1) = 5$.

Answer $y = \dots\dots\dots$ [2]

(b) Simplify $\frac{15w^2 - 30w}{5w^2 - 20}$.

Answer $\dots\dots\dots$ [3]

(c)



The diagram shows the plan of a patio made from rectangular paving slabs.

The width of each paving slab is p cm.

The length of each paving slab is 20 cm longer than its width.

- (i) Find an expression, in terms of p , for the area, in cm^2 , of **one** paving slab.

Answer cm^2 [1]

- (ii) Given that the area of the patio is 12.25 m^2 , show that p satisfies the equation

$$p^2 + 20p - 3500 = 0 .$$

[2]

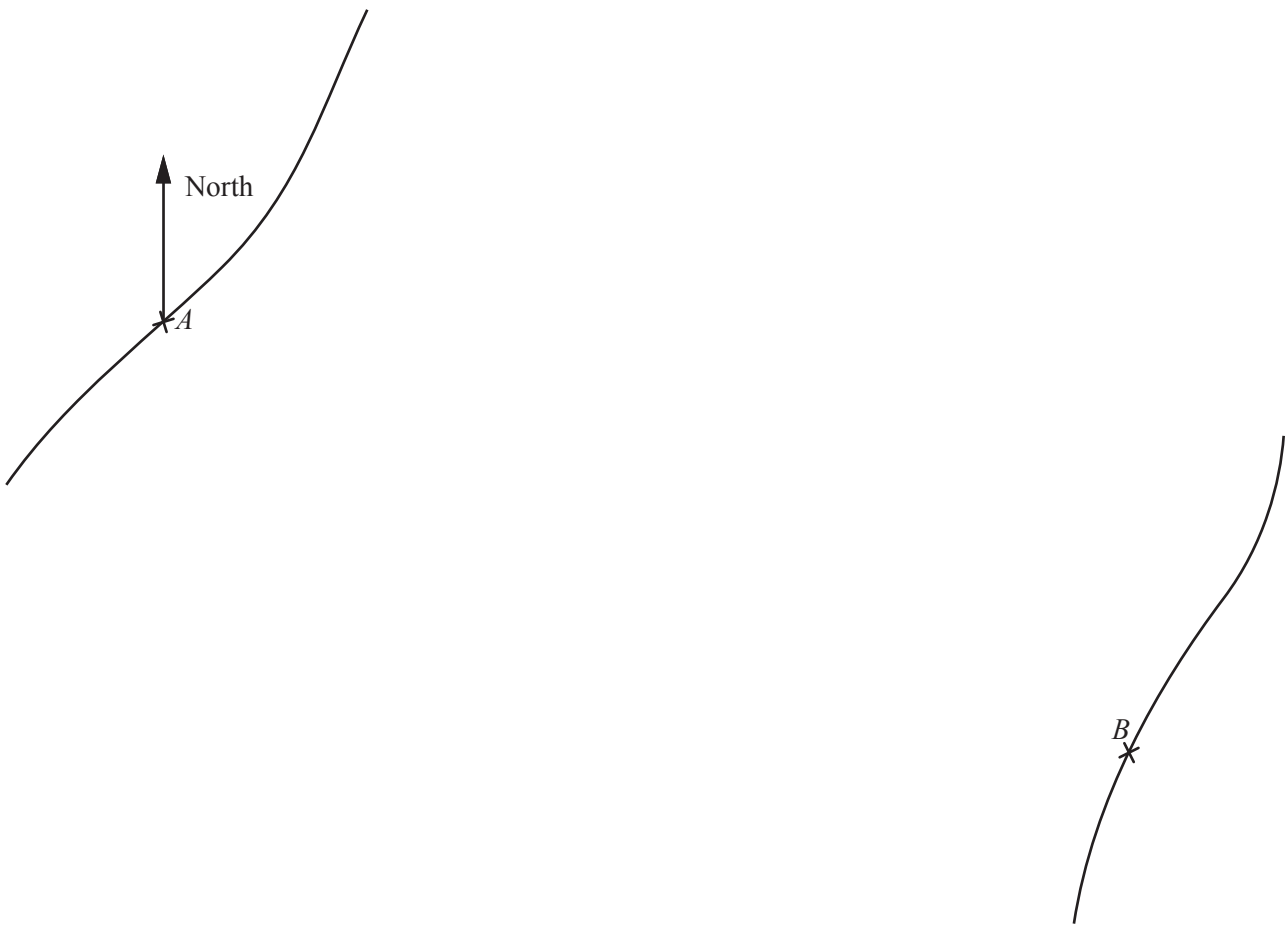
- (iii) (a) Solve by factorisation $p^2 + 20p - 3500 = 0$.

Answer $p =$ or [2]

- (b) Hence state the **length** of each paving slab.

Answer cm [1]

8 (a)



The scale drawing shows two coastal towns, A and B .
The scale of the drawing is 2 cm to 1 km.

- (i) Measure the bearing of B from A .

Answer [1]

- (ii) Draw the locus of points equidistant from A and B . [1]

- (iii) A rock, C , is known to be less than 4 km from B and nearer to A than B .

- (a) Construct and shade the region in which C must lie. [2]

- (b) Find the shortest possible distance between A and C .

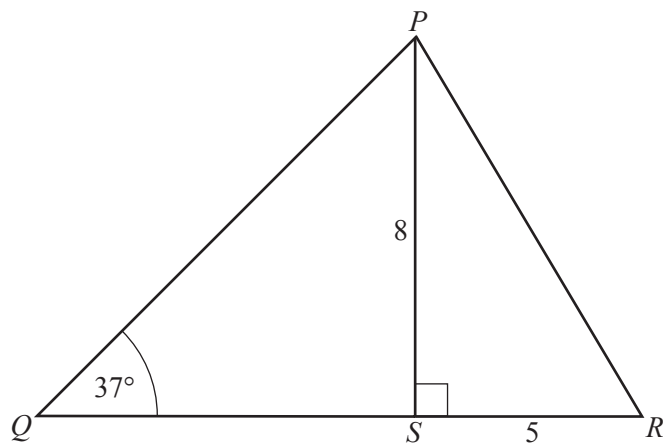
Answer km [1]

- (iv) A boat, D , starts at the point 3.5 km due south of A and sails on a bearing of 075° .

Draw the path of D and state, with a reason, whether it is possible that D collides with C .

Answer [2]

(b)



The diagram shows a triangle PQR with $\hat{PQR} = 37^\circ$.

S is the point on QR such that $\hat{PSR} = 90^\circ$, $PS = 8$ cm and $SR = 5$ cm.

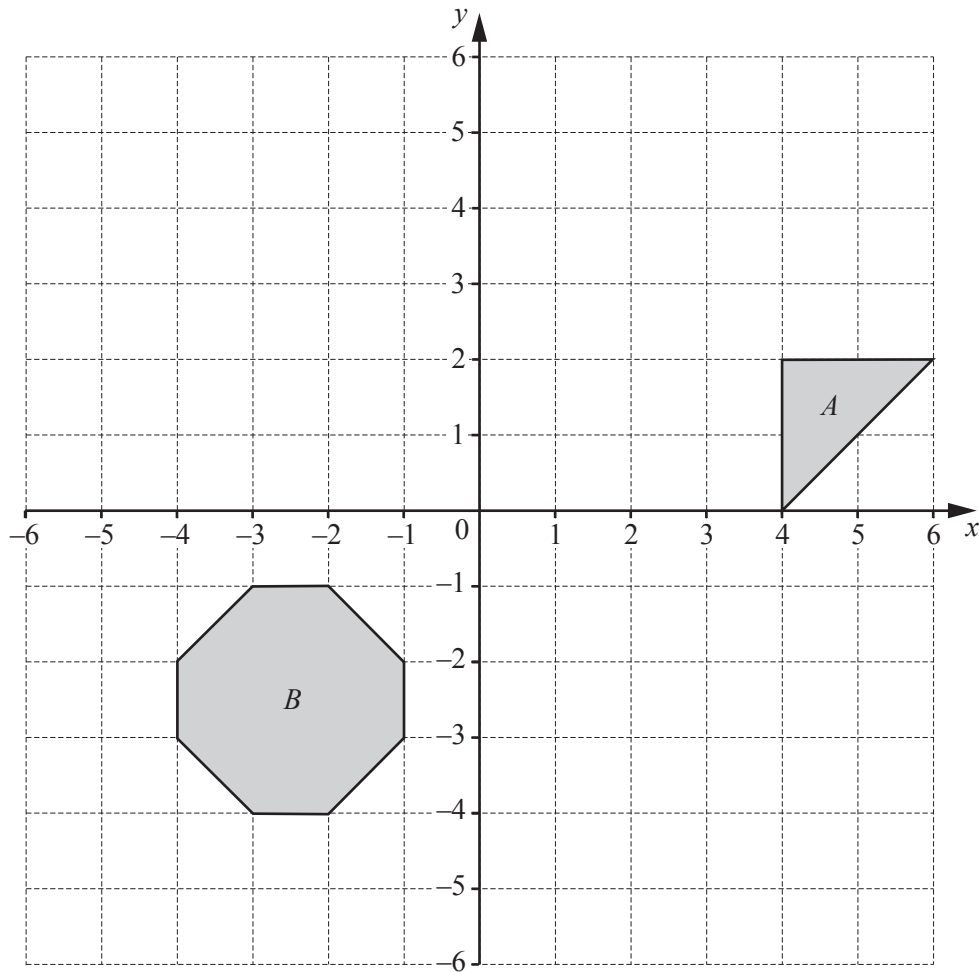
Calculate

(i) PR ,

Answer cm [2]

(ii) the shortest distance from S to PQ .

Answer cm [3]



The diagram shows triangle *A* and octagon *B*.

- (a) Find the gradient of the line of symmetry of triangle *A*.

Answer [1]

- (b) Triangle *A* is mapped onto triangle *C* by a reflection in the line $y = x$.

Draw and label triangle *C*. [2]

- (c) Write down the equation of the line of symmetry of octagon *B* that is parallel to the y -axis.

Answer [1]

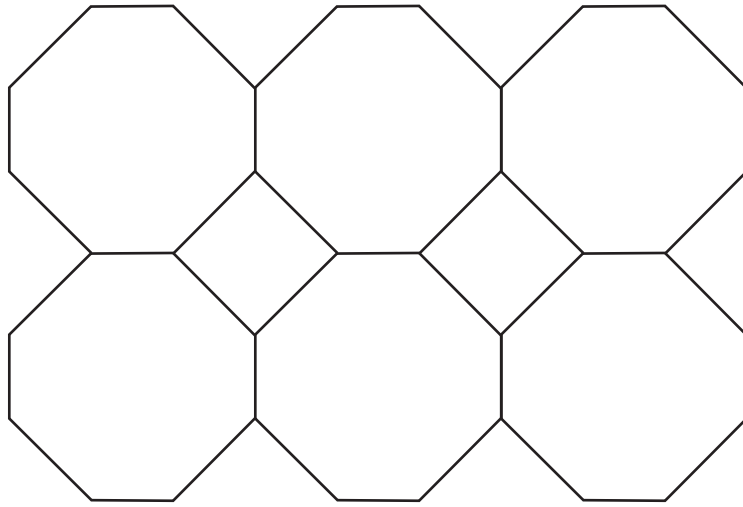
- (d) State the order of rotational symmetry of octagon *B*.

Answer [1]

- (e) Octagon *B* is mapped onto octagon *D* by an enlargement, scale factor 2 and centre $(-3, -3)$.

Draw and label octagon *D*. [2]

- (f) A mat is made from six identical octagons, each **similar** to octagon B , and two squares, as shown in the sketch below.



The lengths of the short sides of the octagons are each 15 cm.

- (i) Calculate the area of one of these octagons.

Answer cm^2 [2]

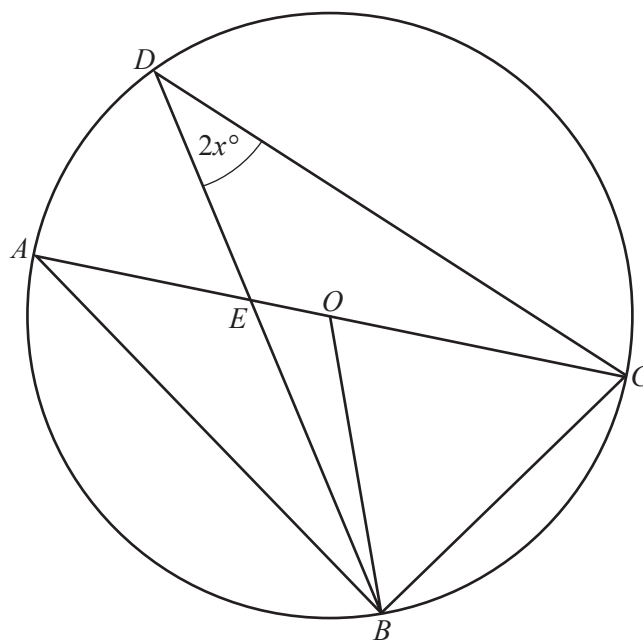
- (ii) Find the length of a diagonal of one of the squares.

Answer cm [1]

- (iii) Calculate the total area of the mat.

Answer cm^2 [2]

10 (a)



A, B, C and D are points on the circumference of a circle, centre O .
 The diameter AC intersects BD at E .
 $\angle BDC = 2x^\circ$.

(i) Find an expression, in terms of x , for

(a) $\angle BAC$,

Answer [1]

(b) $\angle BOC$,

Answer [1]

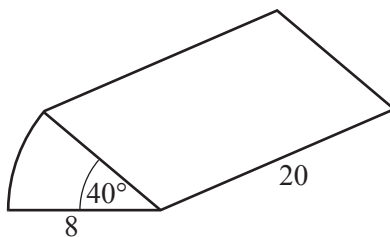
(c) $\angle OCB$.

Answer [1]

(ii) Calculate x when $\angle OBE = x^\circ$ and $\angle DEC = 123^\circ$.

Answer $x =$ [3]

(b)



The cross-section of a prism is a sector of a circle, radius 8 cm and angle 40° .
The prism is 20 cm long.

Calculate

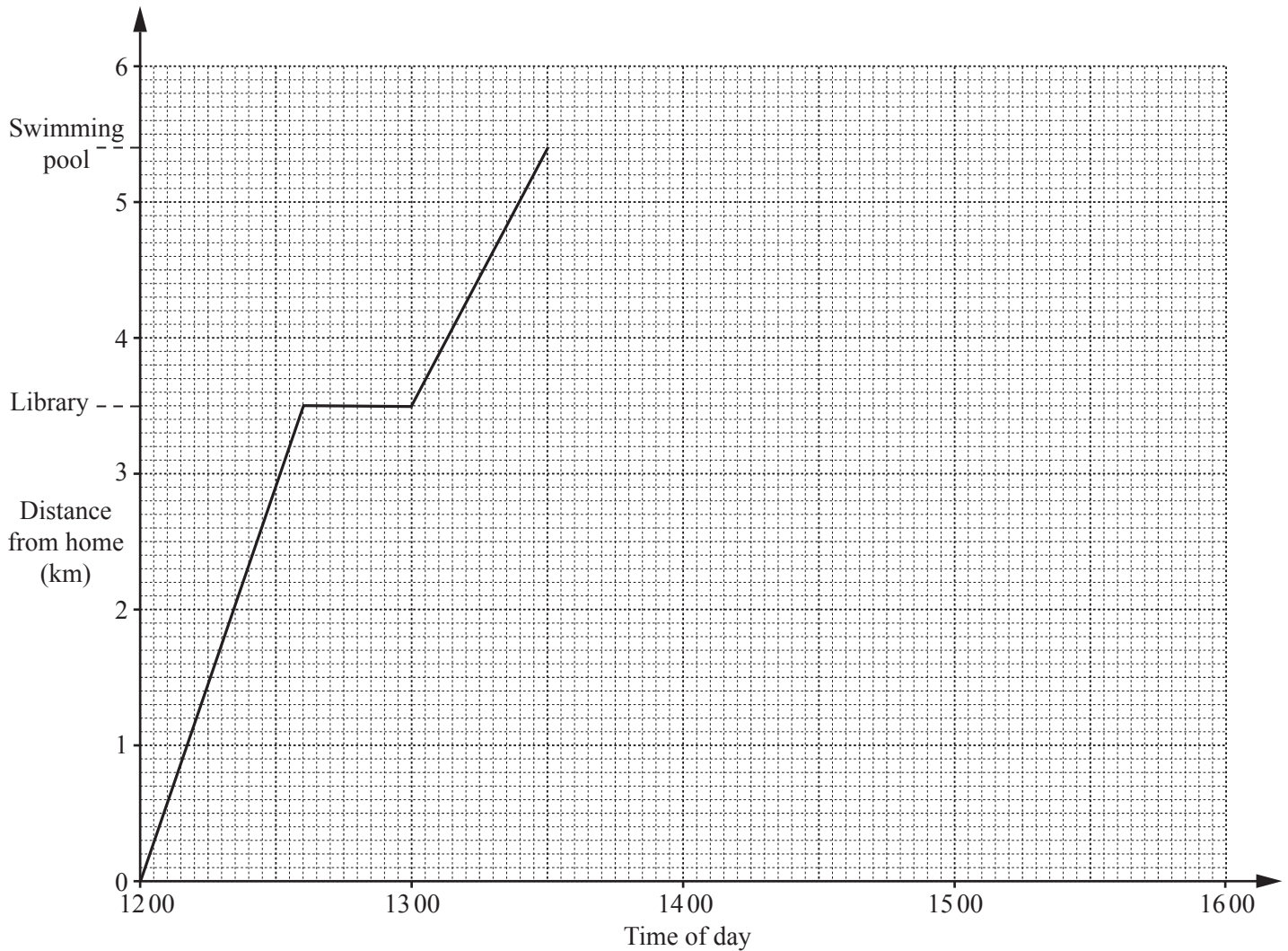
(i) the area of the cross-section,

Answer cm^2 [2]

(ii) the **total** surface area of the prism.

Answer cm^2 [4]

- 11 (a) One day, two brothers, Zac and Tom, leave their home at different times. They meet at the library before going to the swimming pool. The travel graph represents Zac's journey to the swimming pool.



- (i) How much time does Zac spend at the library?

Answer minutes [1]

- (ii) Tom leaves their home at 12 30 and cycles to the library at 14 km/h. Calculate the time Tom arrives at the library.

Answer [1]

- (iii) How far is the swimming pool from the library?

Answer km [1]

- (iv) Zac stays at the swimming pool for an hour and a quarter.
He then walks home at a constant speed, arriving at 15 39 .

(a) Complete his travel graph. [2]

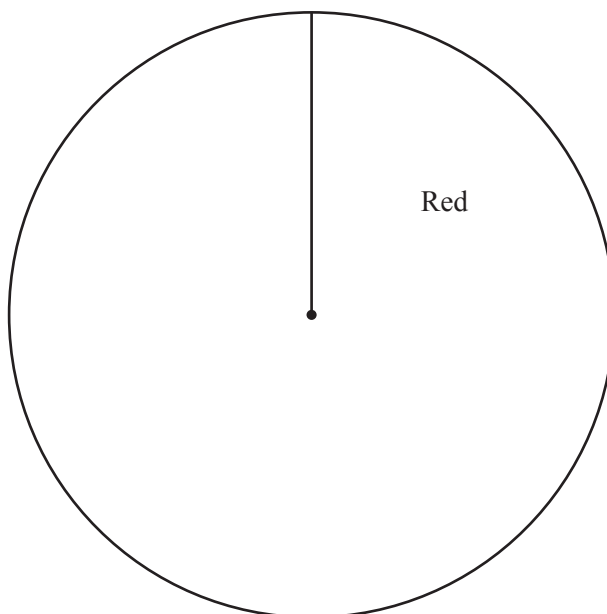
(b) Calculate Zac's speed, in kilometres per hour, as he walks home.

Answer km/h [1]

The rest of this question is on the next page.

(b) A bag contains 5 red counters, 6 blue counters and 1 green counter.

(i) Complete the pie chart to represent this data.



[2]

(ii) Ahmed takes a counter at random from the bag.
Find the probability that the counter is red.

Answer [1]

(iii) Simeon takes two counters at random from the bag of twelve counters.
He places them next to each other on a table.

Find the probability that the two counters are different colours.

Answer [3]

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

October/November 2014

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **23** printed pages and **1** blank page.

Section A [52 marks]

Answer **all** questions in this section.

- 1 (a) In 2013, Mary worked for Company A.
Her salary for the year was \$18 750.

- (i) \$5625 of her salary was not taxed.

What percentage of her salary was not taxed?

Answer % [2]

- (ii) The remaining \$13 125 of Mary's salary was taxed.
22% of this amount was deducted for tax.
Mary's take-home pay was the amount remaining from \$18 750 after tax had been deducted.
She received this in 52 equal amounts as a weekly wage.

Calculate Mary's weekly wage.

Answer \$ [3]

- (iii) In 2012 Mary had worked for Company B.
When she moved from Company B to Company A, her salary increased by 25% to \$18 750.

Calculate her salary when she worked for Company B.

Answer \$ [2]

- (b) The rate of exchange between pounds (£) and Indian rupees (R) is £1 = R87.21.
The rate of exchange between pounds (£) and Swiss francs (F) is £1 = F1.53.

(i) Mavis changed £750 into Indian rupees. How many rupees did she receive?

Answerrupees [1]

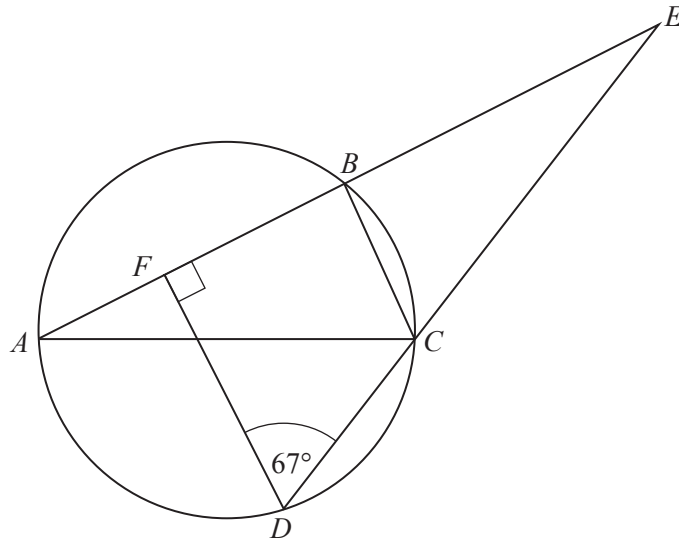
(ii) David changed F450 into pounds. How many pounds did he receive?

Answer £ [1]

(iii) Brian changed R50 000 into Swiss francs. How many Swiss francs did he receive?

Answerfrancs [2]

2 (a)



A, B, C and D are points on the circumference of the circle and AC is a diameter.
 $AFBE$ and DCE are straight lines.
 DF is perpendicular to AE and $\hat{CDF} = 67^\circ$.

(i) Find $\hat{AED}$.

Answer $\hat{AED} = \dots\dots\dots [1]$

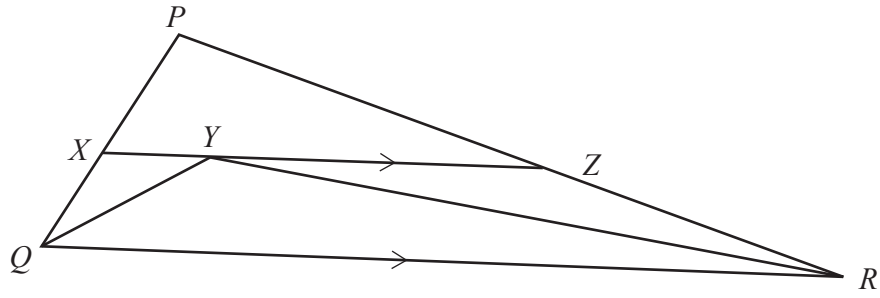
(ii) Find $\hat{CBE}$, giving a reason for your answer.

Answer $\hat{CBE} = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots [1]$

(iii) Explain why DF is parallel to CB .

Answer $\dots\dots\dots$
 $\dots\dots\dots [1]$

(b)

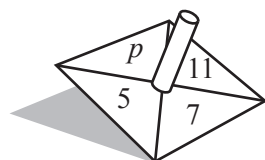
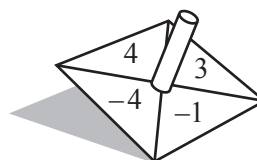


In the triangle PQR , the bisectors of $\angle Q$ and $\angle R$ intersect at Y .
The straight line XYZ is parallel to QR .

Prove that the perimeter of triangle $PXZ = PQ + PR$.

[3]

3

spinner X spinner Y

In a game, when it is Mary's turn, she spins each of these fair spinners once.

Mary's score for the turn is worked out using the formula $xm + yn$, where x is the number on spinner X and y is the number on spinner Y .

The possibility space diagram shows Mary's possible scores.

		x (number on spinner X)			
		5	7	11	p
y (number on spinner Y)	-4	37	47	67	97
	-1	28	38	58	88
	3	16	26	46	76
	4	13	23	43	73

- (a) Find the probability that Mary's score is less than 15.

Answer [1]

- (b) Calculate the probability that on two consecutive turns, Mary scores less than 40 on one and more than 75 on the other.

Answer [3]

- (c) The diagram shows 7 on spinner X and -1 on spinner Y .
Using the formula, the score for this turn is $7m - n = 38$.

- (i) Using the table, find $7m + 3n$.

Answer [1]

- (ii) Hence find m and n .

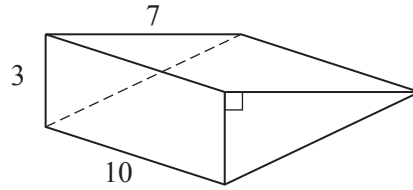
Answer $m =$

$n =$ [2]

- (d) Find p .

Answer $p =$ [2]

4 (a)



The diagram shows a solid triangular prism. The dimensions are in metres.

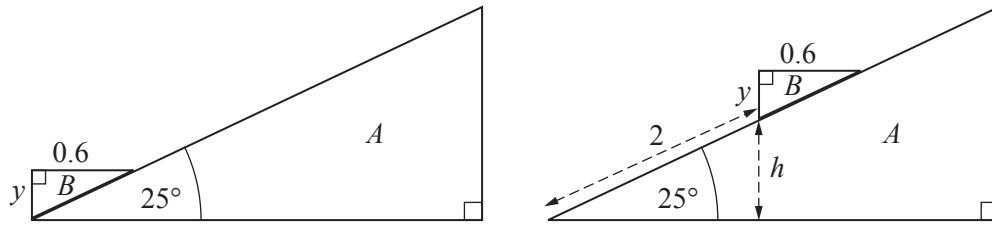
(i) Calculate the volume of the prism.

Answerm³ [2]

(ii) Calculate the total surface area of the prism.

Answerm² [4]

(b)



The diagrams show the cross-sections of a ramp A and a triangular prism B .
 The triangular prism B can move up and down the ramp A .
 The ramp is inclined at 25° to the horizontal.

- (i) When the prism has moved 2 m up the ramp, it has risen h metres vertically.

Calculate h .

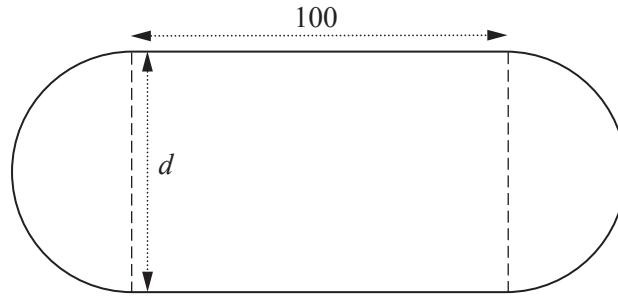
Answer $h = \dots\dots\dots$ [2]

- (ii) As it moves, the uppermost face of the prism B remains horizontal.
 The length of the horizontal edge of the face is 0.6 m.
 The length of the vertical edge of the prism is y metres.

Calculate y .

Answer $y = \dots\dots\dots$ [2]

5



The diagram shows the perimeter of a 400 m running track.
 It consists of a rectangle measuring 100 m by d metres and two semicircles of diameter d metres.
 The length of each semicircular arc is 100 m.

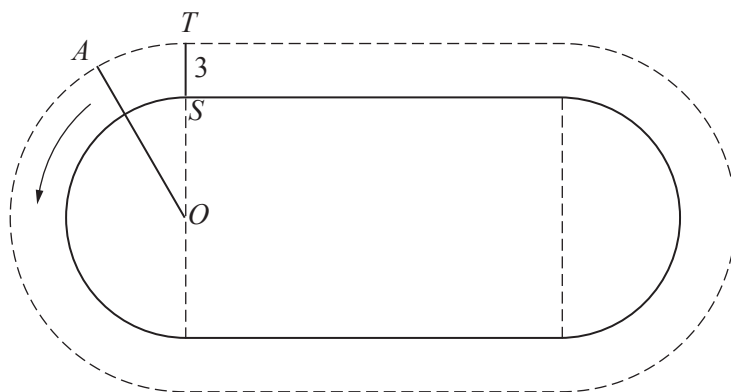
(a) Calculate d .

Answer $d = \dots\dots\dots$ [2]

(b) Calculate the total area of the region inside the running track.

Answer $\dots\dots\dots\text{m}^2$ [3]

(c)



S is the starting point and finishing point for the 400 m race for a runner in the inside lane.
 A runner in an outer lane is always 3 m from the inner perimeter.
 The runner in the outer lane starts at A , runs 400 m and finishes at T .
 $TS = 3$ m.

- (i) Calculate the length of the arc TA .

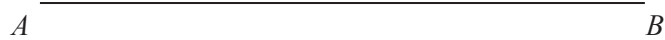
Answer m [3]

- (ii) O is the centre of a semi-circular part of the track.

Calculate $\hat{AOT}$.

Answer $\hat{AOT} =$ [2]

- 6 $ABCD$ is a field in the shape of a trapezium.
 $\hat{ABC} = 56^\circ$, $\hat{BAD} = 104^\circ$ and the distance between the parallel sides of the field is 90 m.
- (a) Using a scale of 1 cm to 20 m, draw a plan of the field.
 AB has been drawn for you.



[4]

- (b) Find the actual distance CD .

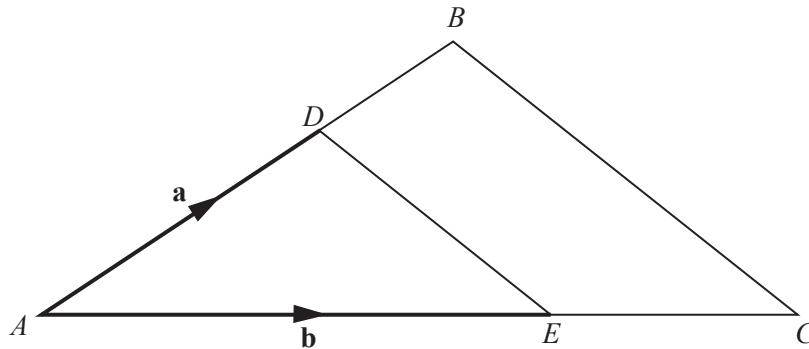
Answer $CD = \dots\dots\dots$ m [2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

7 (a)



In the triangle ABC , D divides AB in the ratio $3 : 2$, and E divides AC in the ratio $3 : 2$.
 $\vec{AD} = \mathbf{a}$ and $\vec{AE} = \mathbf{b}$.

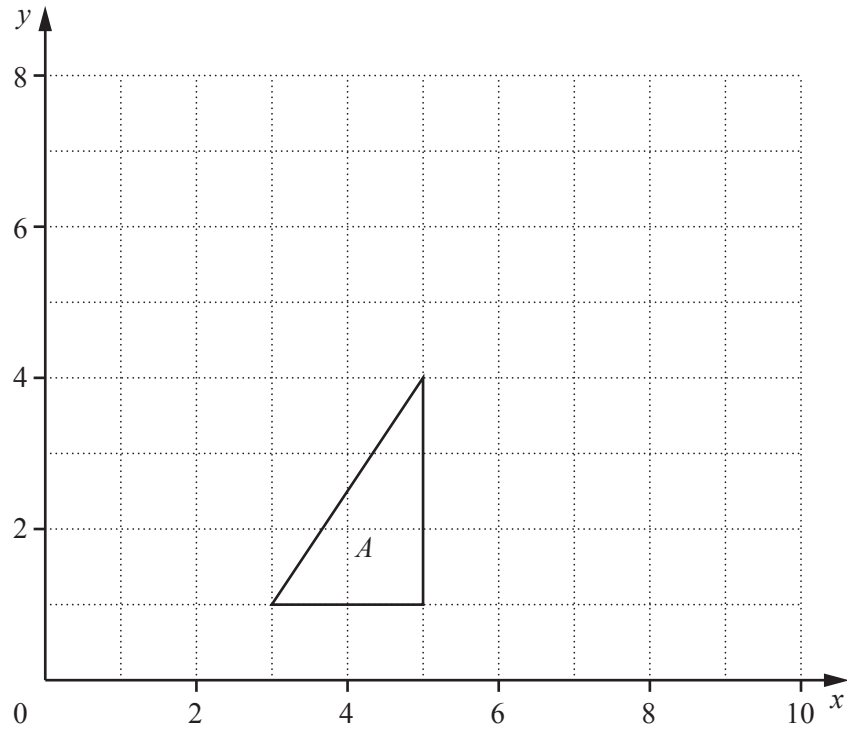
(i) Show, using vectors, that DE is parallel to BC .

[3]

(ii) Find the ratio Area of triangle ADE : Area of triangle ABC .

Answer :[2]

(b)



Triangle A has vertices $(3, 1)$, $(5, 1)$ and $(5, 4)$.

The transformation S_1 is represented by the matrix $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$.

S_1 maps triangle A onto triangle B .

(i) Draw and label triangle B .

[2]

(ii) What type of transformation is S_1 ?

Answer [1]

- (iii) The transformation S_2 is represented by the matrix $\begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}$.

Find the matrix that represents the combined transformation S_2S_1 .

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

- (iv) The combined transformation S_2S_1 maps triangle A onto triangle C .

Find the matrix which represents the transformation that maps triangle C onto triangle A .

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

8 (a) $T = 2\pi\sqrt{\frac{h}{g}}$

(i) Find T when $h = 125$ and $g = 981$.

Answer $T = \dots\dots\dots$ [1]

(ii) Make h the subject of the formula.

Answer $h = \dots\dots\dots$ [3]

(b) Solve the equation $45 - (p + 3) = 2p$.

Answer $p = \dots\dots\dots$ [2]

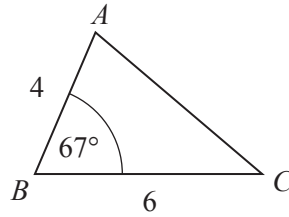
- (c) Solve the equation $\frac{2x-3}{4} + \frac{5-x}{3} = 0$.

Answer $x = \dots\dots\dots$ [3]

- (d) Solve the equation $3y^2 + 11y + 4 = 0$.
Give your answers correct to 2 decimal places.

Answer $y = \dots\dots\dots$ or $\dots\dots\dots$ [3]

9 (a)

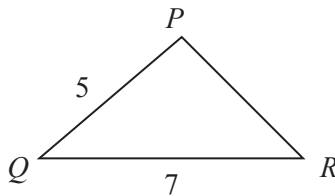


In triangle ABC , $AB = 4$ m, $BC = 6$ m and $\hat{ABC} = 67^\circ$.

- (i) Show that the area of triangle ABC is 11.05 m^2 correct to 2 decimal places.

[1]

(ii)

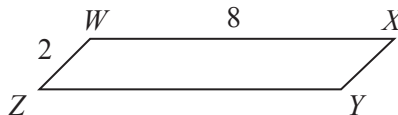


In triangle PQR , $PQ = 5$ m and $QR = 7$ m.
Area of triangle PQR = Area of triangle ABC .

Find the acute angle PQR .

Answer [2]

(iii)



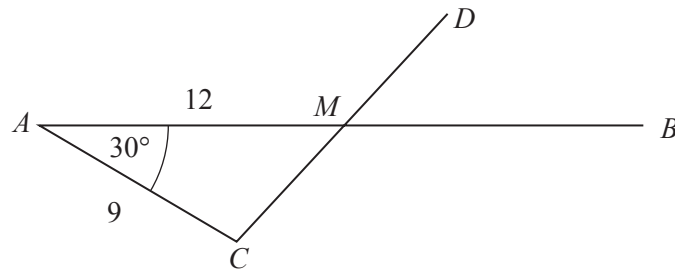
In the parallelogram $WXYZ$, $WX = 8$ m and $WZ = 2$ m.
Area of parallelogram $WXYZ$ = Area of triangle ABC .

Find the obtuse angle ZWX .

Answer [3]

(b) AB , AC and CD are three rods. They can be fixed together in different positions.

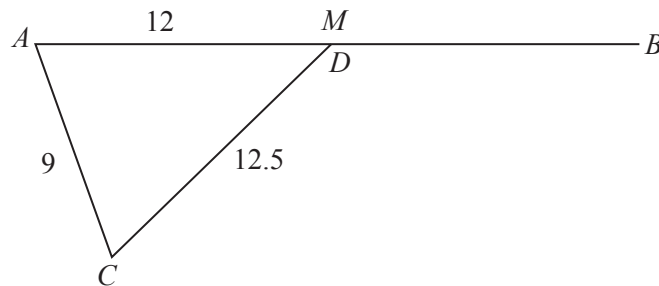
(i) $AC = 9$ cm and M is a fixed point on AB such that $AM = 12$ cm.



When $\hat{CAM} = 30^\circ$, calculate CM .

Answer $CM = \dots\dots\dots$ cm [3]

(ii)



In another position, the end D of the rod CD is fixed at the point M .
 $CD = 12.5$ cm.

Calculate the increase in $\hat{CAM}$.

Answer $\dots\dots\dots$ [3]

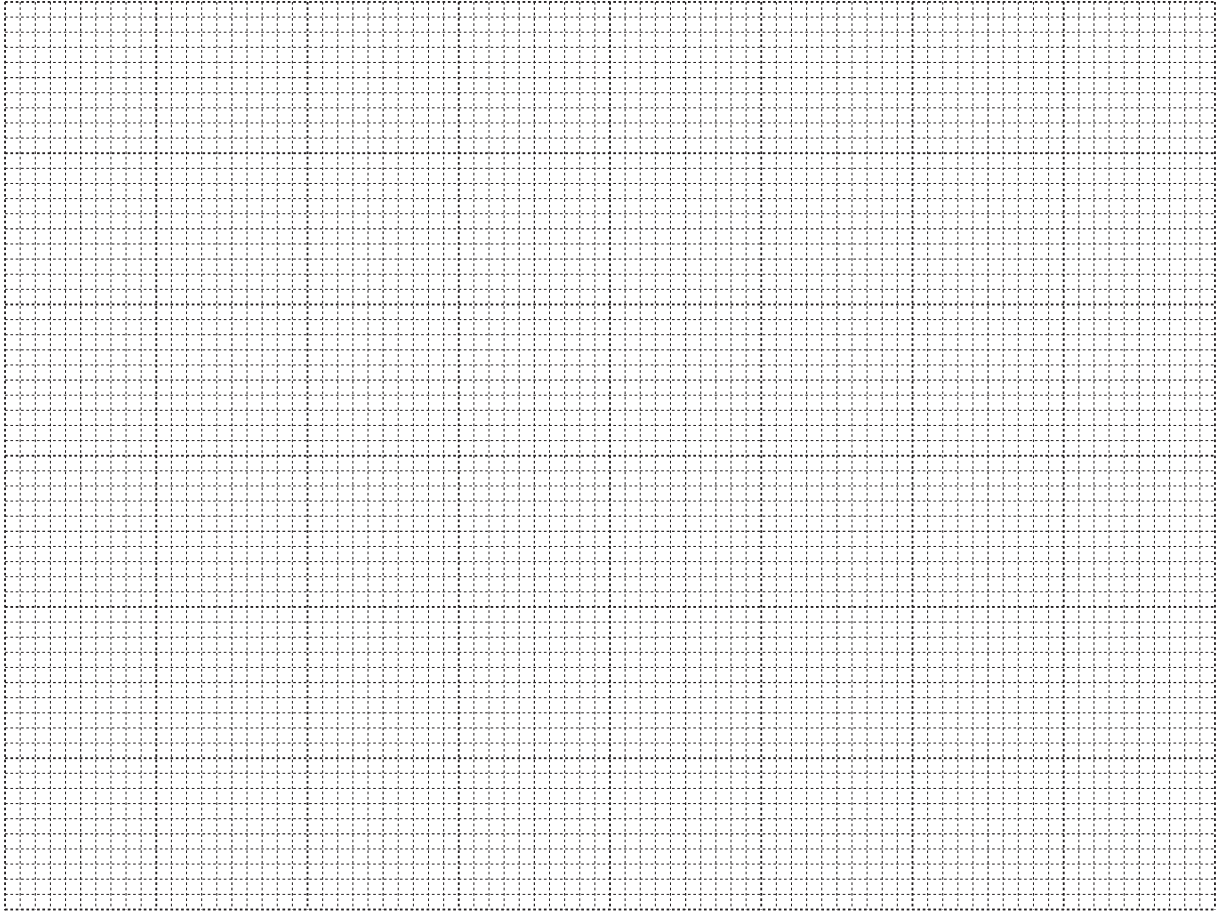
10 The table below is for $y = x^2 - 4x - 1$.

x	-2	-1	0	1	2	3	4	5	6
y		4	-1	-4	-5	-4	-1	4	

(a) Complete the table.

[1]

(b) Using a scale of 2 cm to 1 unit, draw a horizontal x -axis for $-2 \leq x \leq 6$.
 Using a scale of 2 cm to 5 units, draw a vertical y -axis for $-10 \leq y \leq 15$.
 Plot the points from the table and join them with a smooth curve.



[3]

(c) By drawing a tangent, estimate the gradient of the curve at $x = 3$.

Answer [2]

- (d) (i) Find the least value of y .

Answer [1]

- (ii) $y \leq 4$ for $a \leq x \leq b$.

Find the least possible value of a and the greatest possible value of b .

Answer a

b [2]

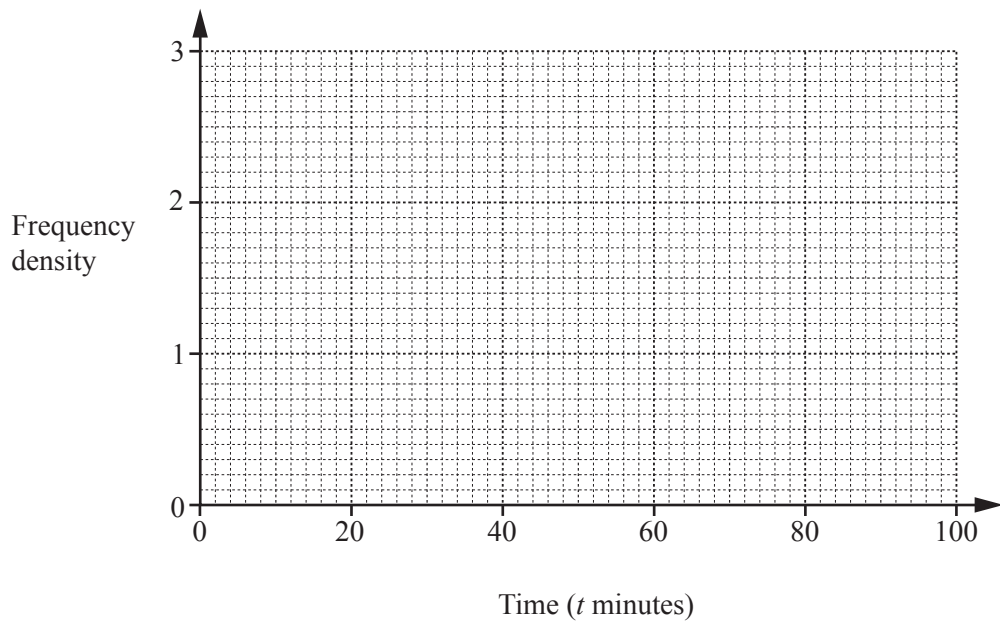
- (e) **Use your graph** to solve the equation $x^2 - 4x + 2 = 0$.
Show your working to explain how you used your graph.

Answer [3]

- 11 (a) 100 students were each asked how long they spent talking on their mobile phone during one day. The results are summarised in the table.

Time (t minutes)	$0 < t \leq 10$	$10 < t \leq 20$	$20 < t \leq 40$	$40 < t \leq 60$	$60 < t \leq 80$	$80 < t \leq 100$
Frequency	10	30	12	16	20	12

On the axes below, draw a histogram to represent these results.

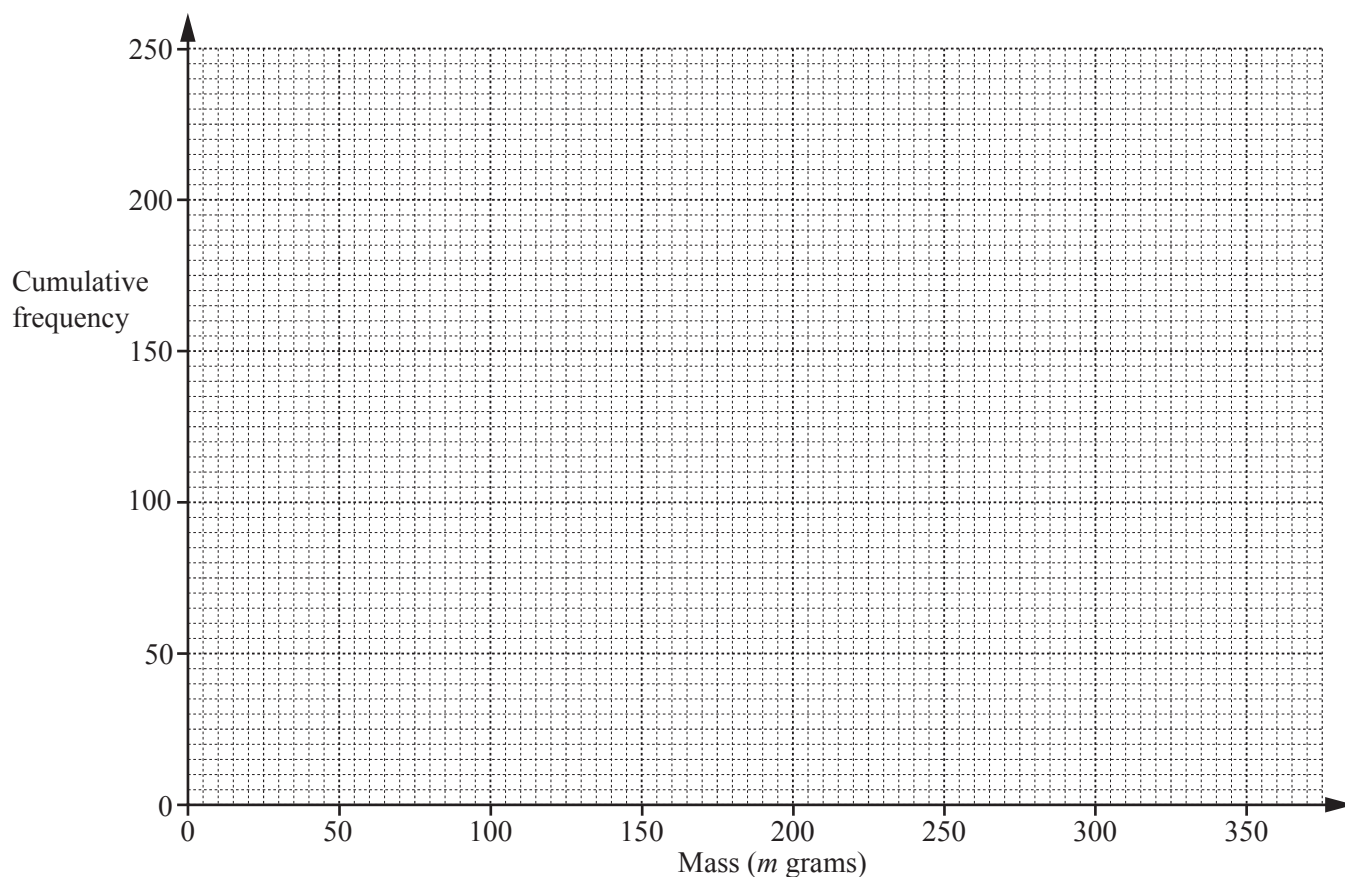


[3]

- (b) The masses, in grams, of 240 potatoes were found. The **cumulative** frequency table for these results is shown below.

Mass (m grams)	$m \leq 50$	$m \leq 100$	$m \leq 150$	$m \leq 200$	$m \leq 250$	$m \leq 300$	$m \leq 350$
Cumulative frequency	0	4	54	132	204	236	240

- (i) Draw a smooth cumulative frequency curve to illustrate this information.



[2]

- (ii) (a) Find the median.

Answer [1]

- (b) Find the inter-quartile range.

Answer [2]

- (iii) Complete the frequency table below.

Mass (m grams)	$50 < m \leq 100$	$100 < m \leq 150$	$150 < m \leq 200$	$200 < m \leq 250$	$250 < m \leq 300$	$300 < m \leq 350$
Frequency	4					

[1]

- (iv) A potato with a mass greater than 250 grams is classed as extra large.

- (a) How many of these potatoes are extra large?

Answer [1]

- (b) Which percentile of the distribution can be used to find this number?

Answer [2]

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4024/21

October/November 2015

2 hours 30 minutes

Additional Materials: Geometrical instruments
Electronic calculator

READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

The total of the marks for this paper is 100.

This document consists of **19** printed pages and **1** blank page.

Section A [52 marks]

Answer **all** questions in this section.

- 1 (a) Tim invests \$2500 in a bank paying simple interest at 2.3% per year.
What is the total amount of money in the bank at the end of 4 years?

Answer \$ [2]

(b)

TABLET

\$750

FINANCE OFFER

Pay 15% of \$750 as deposit and
36 monthly payments of \$25.

Chris buys the tablet using the finance offer.
How much more does he pay than if he had paid \$750 for it?

Answer \$ [2]

- (c) Lavin buys some sweets, pens and paper at her local shop.
The shop is offering 20% discount on all items.
This is her receipt.

Items and prices	Cost (\$)
0.3 kg of sweets at \$15.50 per kg	w
6 pens at \$ x per pen	4.50
Paper	z
Total before discount	y
Total after discount	32.40

Find the missing values w , x , y and z .

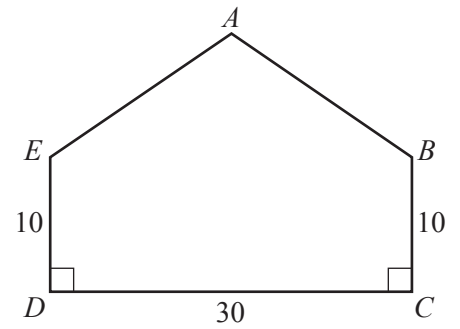
Answer $w =$

$x =$

$y =$

$z =$ [5]

- 2 (a) $ABCDE$ is a pentagon with one line of symmetry.
 $BC = DE = 10$ cm, $DC = 30$ cm and $\hat{BCD} = \hat{CDE} = 90^\circ$.
 The shortest distance between A and DC is 22 cm.



- (i) Calculate AB .

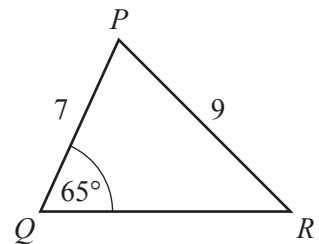
Answer cm [2]

- (ii) Calculate $\hat{ABC}$.

Answer [3]

- (b) In triangle PQR , $PQ = 7$ cm, $PR = 9$ cm and $\hat{PQR} = 65^\circ$.

Calculate $\hat{PRQ}$.



Answer [3]

3 (a) $\mathbf{A} = \begin{pmatrix} 1 & 3 \\ -2 & 2 \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} -1 & 2 \\ -3 & 2 \end{pmatrix}$

Find

(i) $2\mathbf{A} - \mathbf{B}$,

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(ii) $\mathbf{B}^{-1}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(b) The matrix $\mathbf{C}$ satisfies the following equation.

$$3\mathbf{C} + 4 \begin{pmatrix} -2 & 1 \\ 0 & 3 \end{pmatrix} = \mathbf{C}$$

Find $\mathbf{C}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

- (c) Theresa sells raspberries and blackcurrants.
 The first matrix shows the number of kilograms of each fruit she sells during three different weeks.
 The second matrix shows the price per kilogram, in cents, of the fruit Theresa sells.

	raspberries	blackcurrants	price/kg	
Week 1	$\begin{pmatrix} 3 & 2 \\ 1.5 & 3 \\ 2 & 2.5 \end{pmatrix}$		$\begin{pmatrix} 650 \\ 580 \end{pmatrix}$	raspberries
Week 2				blackcurrants
Week 3				

(i) $\mathbf{D} = \begin{pmatrix} 3 & 2 \\ 1.5 & 3 \\ 2 & 2.5 \end{pmatrix} \begin{pmatrix} 650 \\ 580 \end{pmatrix}$

Find $\mathbf{D}$.

Answer [2]

- (ii) Explain the meaning of the information given by matrix $\mathbf{D}$.

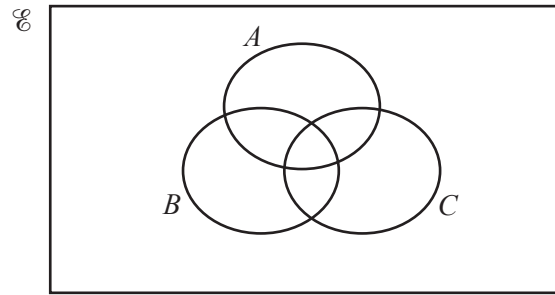
Answer [1]

- (iii) Find the total amount, in dollars, that Theresa gets for the fruit she sells.

Answer \$ [1]

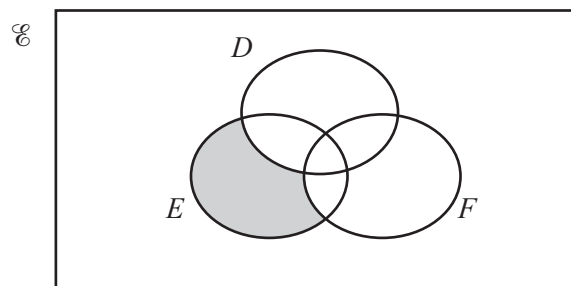
- 4 (a) Shade the subset $(A \cap B) \cup C$.

Answer



[1]

- (b) Use set notation to describe the subset shaded in the diagram.

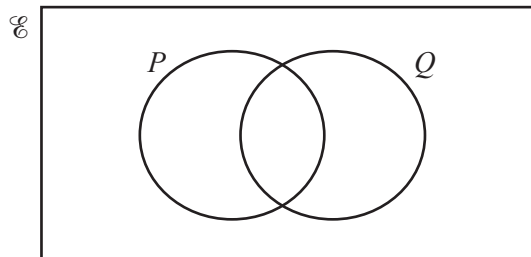


Answer [1]

- (c) $\mathcal{E} = \{ 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 \}$
 $P = \{ x : x \text{ is an odd number} \}$
 $Q = \{ x : x \text{ is a square number} \}$

- (i) Write the members of $\mathcal{E}$ in the correct regions on the Venn diagram.

Answer



[2]

- (ii) State $n(Q')$.

Answer [1]

- (iii) A number, m , is chosen at random from $\mathcal{E}$.

Find the probability that m is a member of $P \cap Q'$.

Answer [2]

- 5 (a) Factorise completely $6x^2y^3 - 15x^3y$.

Answer [2]

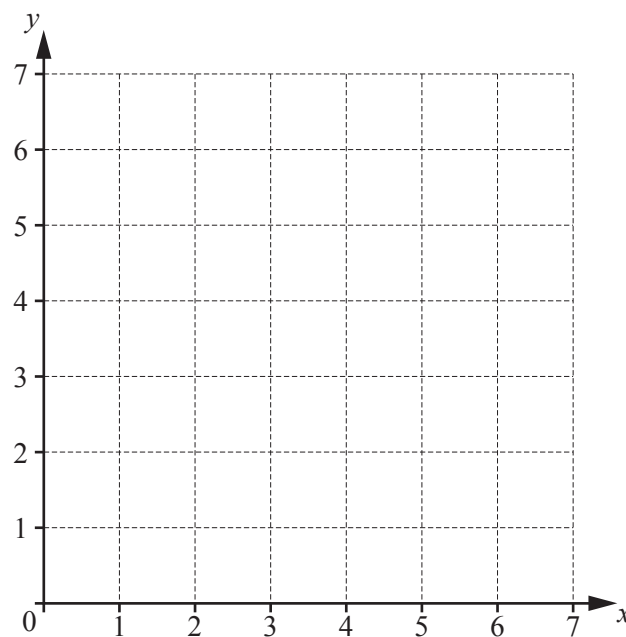
- (b) Solve $\frac{4}{x} + \frac{2}{x+2} = 3$.

Answer $x =$ or [3]

- (c) (i) Shade and **label** the region R defined by these four inequalities.

$$x \geq 1 \qquad y \leq 4 \qquad x + y \leq 6 \qquad y \geq x$$

Answer



[3]

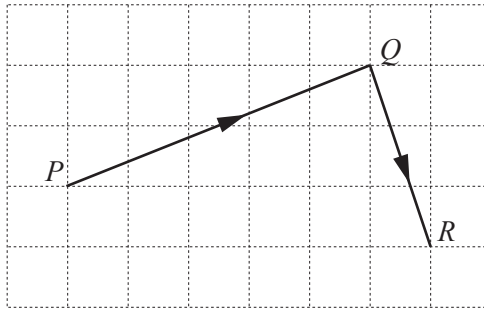
- (ii) The point M is the intersection of $x = 1$ and $y = 4$.
The point N is the intersection of $x + y = 6$ and $y = x$.

Find the gradient of MN .

Answer [2]

- 6 (a) The diagram shows the vectors $\overrightarrow{PQ}$ and $\overrightarrow{QR}$.

$$\overrightarrow{PQ} = \begin{pmatrix} 5 \\ 2 \end{pmatrix} \text{ and } \overrightarrow{QR} = \begin{pmatrix} a \\ b \end{pmatrix}.$$



- (i) Find a and b .

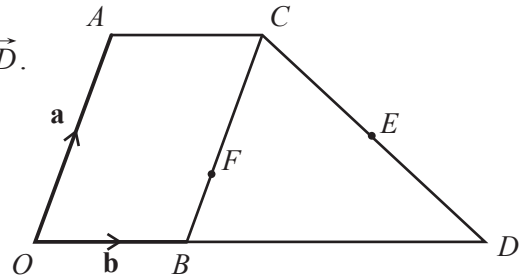
Answer $a = \dots\dots\dots b = \dots\dots\dots$ [2]

- (ii) Calculate $|\overrightarrow{PQ}|$.

Answer $\dots\dots\dots$ [2]

- (b) $OACB$ is a parallelogram.

$\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and D is the point such that $2\overrightarrow{OB} = \overrightarrow{BD}$.
 E is the midpoint of CD .



- (i) Express $\overrightarrow{CE}$, as simply as possible, in terms of $\mathbf{a}$ and $\mathbf{b}$.

Answer $\dots\dots\dots$ [1]

- (ii) Express $\overrightarrow{OE}$, as simply as possible, in terms of $\mathbf{a}$ and $\mathbf{b}$.

Answer $\dots\dots\dots$ [1]

- (iii) F is a point on BC such that $\overrightarrow{OF} = k\overrightarrow{OE}$.
 Find $BF : FC$.

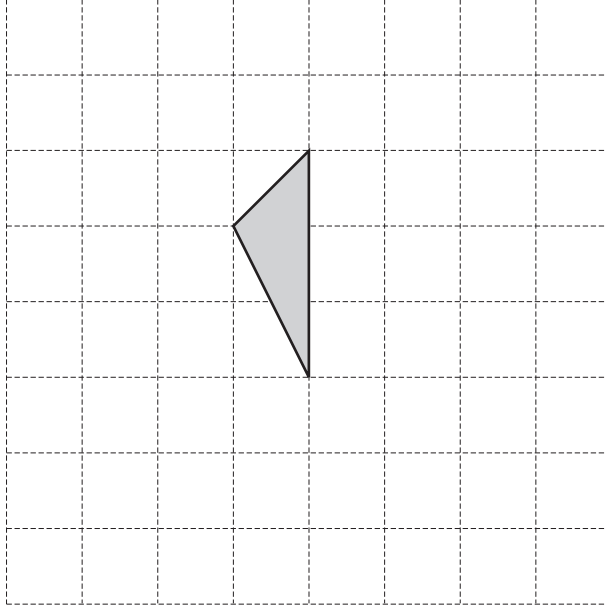
Answer $\dots\dots\dots : \dots\dots\dots$ [2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

7 (a)

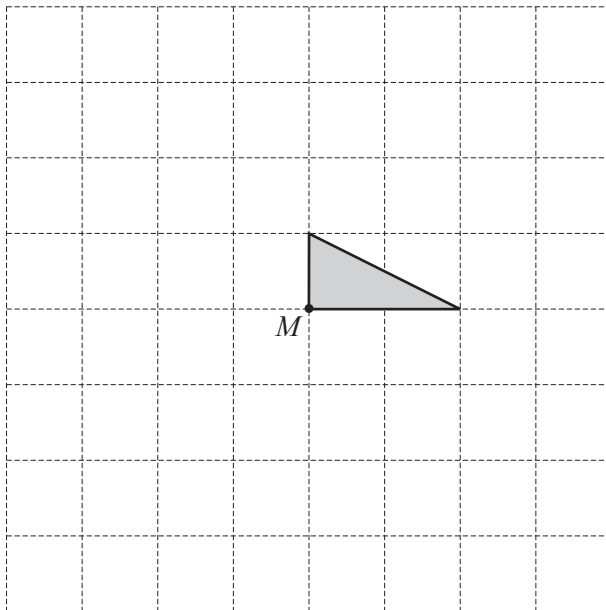


The shaded triangle, drawn on the grid, is part of a quadrilateral with one line of symmetry. The area of the quadrilateral is twice the area of the triangle.

Given that the line of symmetry is **not** vertical, complete the quadrilateral.

[1]

(b)

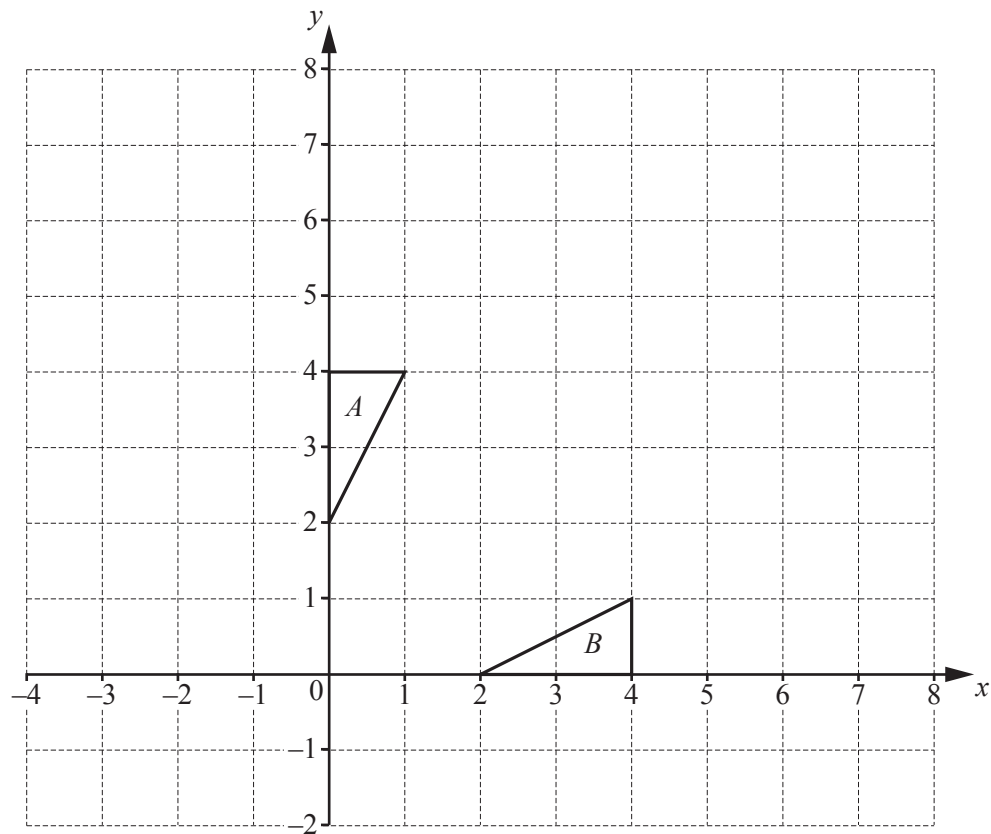


The shaded triangle, drawn on the grid, is part of a shape whose area is 4 times the shaded area and has rotational symmetry of order 4 about M .

Complete the shape.

[2]

(c)



The diagram shows triangle A and triangle B .

- (i) Triangle A is mapped onto triangle C by the translation P with vector $\begin{pmatrix} 3 \\ -1 \end{pmatrix}$.

Draw and label triangle C .

[2]

- (ii) Triangle A is mapped onto triangle B by a reflection Q .

Write down the equation of the line of this reflection.

Answer [1]

- (iii) Triangle C is mapped onto triangle D by reflection Q .

Describe fully the **single** transformation that maps triangle B onto triangle D .

Answer [2]

- (iv) Transformation R is a reflection in the line $y = 0$.

$$RQ(A) = E.$$

- (a) Find the coordinates of the vertices of triangle E .

Answer [1]

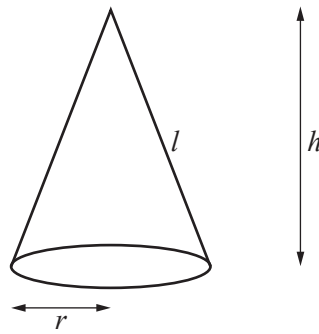
- (b) Describe fully the **single** transformation that maps triangle A onto triangle E .

Answer

..... [2]

- (c) Find the matrix which represents the transformation that maps triangle A onto triangle E .

Answer [1]

8 [Curved surface area of a cone = πrl]

The diagram shows a solid cone with radius r cm, height h cm and slant height l cm.

Suleman makes some solid cones.

The slant height of each of his cones is 4 cm more than its radius.

Use $\pi = 3$ throughout this question.

- (a) Show that the **total** surface area, A cm², of each of Suleman's cones is given by $A = 6r(r + 2)$.

[2]

- (b) Complete the table for $A = 6r(r + 2)$.

r	0	1	2	3	4	5	6
A	0	18			144	210	288

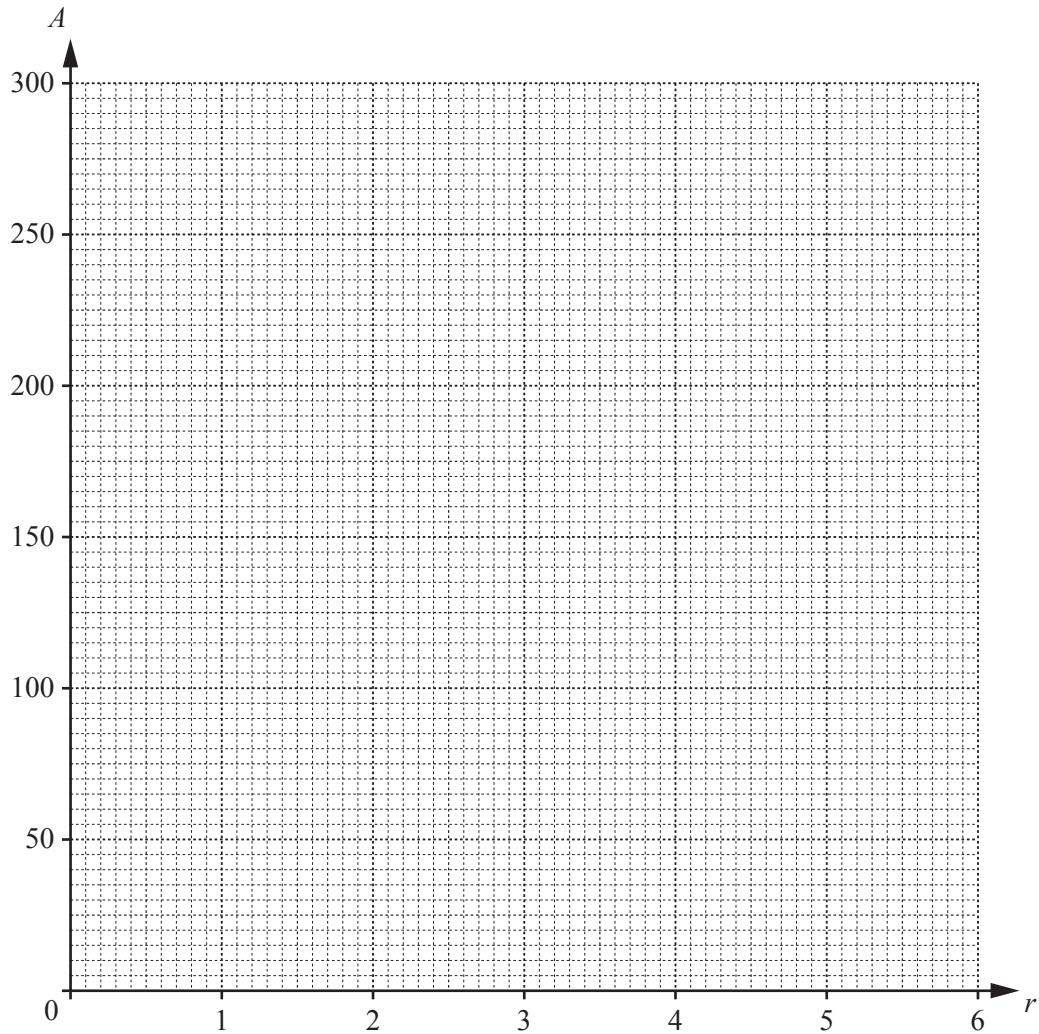
[1]

- (c) On the grid opposite, draw the graph of $A = 6r(r + 2)$.

[2]

- (d) Find an expression for h in terms of r .

Answer $h = \dots\dots\dots$ [2]



- (e) The height of one of Suleman's cones is 12 cm.
Calculate its radius.

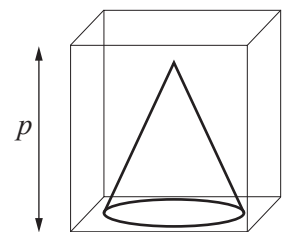
Answer cm [2]

- (f) Another of Suleman's cones has a surface area of 200 cm^2 .

- (i) Use your graph to find the radius of this cone.

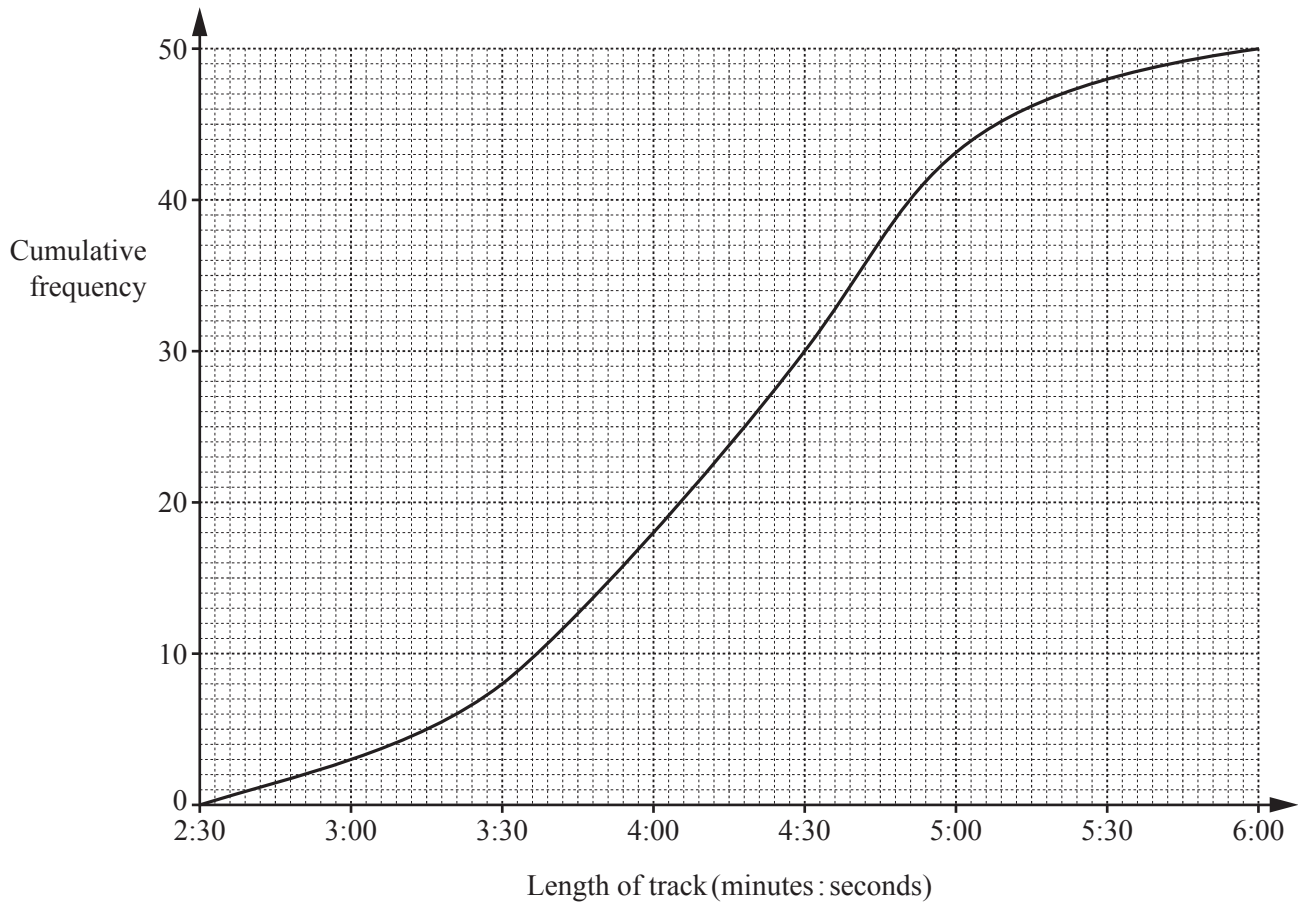
Answer cm [1]

- (ii) This cone is placed in a box of height p cm, where p is an integer.
Find the smallest possible value of p .



Answer $p =$ [2]

- 9 The cumulative frequency graph for the lengths of the 50 tracks on Abi's MP3 player is shown below.



- (a) Use the graph to find

- (i) the median,

Answer minutes seconds [1]

- (ii) the interquartile range.

Answer minutes seconds [2]

- (b) Use the information on the graph to complete the frequency table for the length of the tracks.

Length (minutes : seconds)	Frequency
$2:30 < \text{length} \leq 3:00$	3
$3:00 < \text{length} \leq 3:30$	5
$3:30 < \text{length} \leq 4:00$	
$4:00 < \text{length} \leq 4:30$	
$4:30 < \text{length} \leq 5:00$	
$5:00 < \text{length} \leq 5:30$	
$5:30 < \text{length} \leq 6:00$	

[2]

- (c) Abi plays three tracks from her MP3 player with no break between them.

Given that no track is repeated, what is the maximum possible length of time taken to play these tracks?

Answer minutes seconds [2]

- (d) Abi travels on a train from station *A* to station *F*.

The exact times the train arrives at and leaves stations *A* to *F* are shown below.

Station	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>
Arrive	–	10 03	10 06	10 11	10 15	10 21
Depart	09 58	10 04	10 07	10 12	10 16	–

- (i) How many minutes did her journey take?

Answer [1]

- (ii) Abi starts playing tracks at random from her MP3 player as she leaves station *A*.

What is the probability that the first track is still playing when she arrives at station *B*?

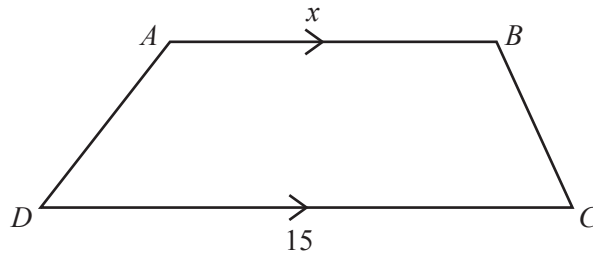
Answer [2]

- (e) Abi plays two different tracks at random from her MP3 player.

What is the probability that neither track is longer than 3 minutes 30 seconds?

Answer [2]

10 (a)



$ABCD$ is a trapezium with AB parallel to DC .

$DC = 15$ cm and $AB = x$ cm.

The perpendicular distance between AB and DC is 3 cm less than the length of AB .

The area of $ABCD$ is 75 cm^2 .

(i) Show that $x^2 + 12x - 195 = 0$.

[2]

(ii) Find AB , giving your answer correct to 1 decimal place.

Answer cm [3]

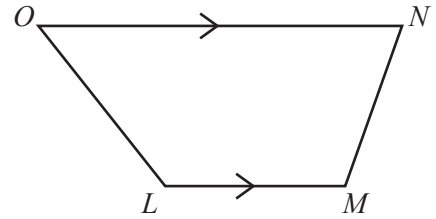
(iii) AD is 0.8 cm longer than BC .

Given that the perimeter of the trapezium is 38.0 cm, calculate AD .

Answer cm [2]

- (b) Another trapezium, $LMNO$, has LM parallel to ON .
The reflex angle $LMN = 252^\circ$.

- (i) Calculate $\hat{MNO}$.



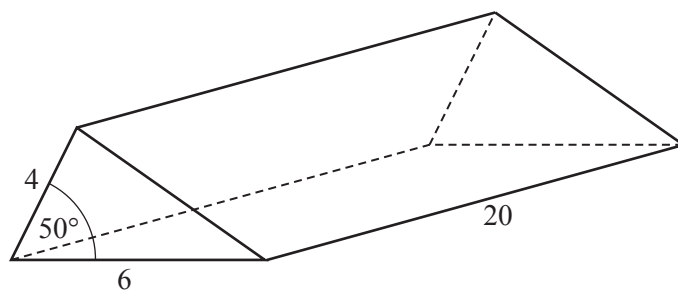
Answer [2]

- (ii) The ratios of the angles inside the trapezium are $\hat{LON} : \hat{LMN} = 1 : 2$ and $\hat{OLM} : \hat{MNO} = 1 : k$.

Find k , giving your answer as a fraction in its simplest form.

Answer [3]

11 (a)



The diagram shows a solid triangular prism.
All lengths are given in centimetres.

(i) Calculate the area of the cross-section of the prism.

Answercm² [2]

(ii) Calculate the volume of the prism.

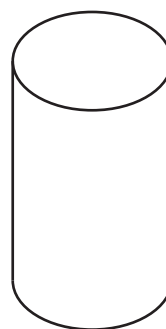
Answercm³ [1]

(iii) Calculate the **total** surface area of the prism.

Answercm² [5]

- (b) A cylinder has a height of 70 cm and a volume of 0.1 m^3 .

Calculate the radius of the cylinder, giving your answer in centimetres.



Answer cm [4]

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

October/November 2015

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **24** printed pages.

Section A [52 marks]

Answer **all** questions in this section

1 (a) Fatima and Mohammed buy new bikes.

- (i)** Fatima buys a city bike costing \$360.
She pays 60% of the cost then pays \$15 per month for 12 months.

(a) How much does Fatima pay altogether?

Answer \$..... [2]

(b) Express this amount as a percentage of the original cost.

Answer % [1]

- (ii) Mohammed pays \$569.80 for a mountain bike in a sale.
The original price had been reduced by 26%.

Calculate the original price of the mountain bike.

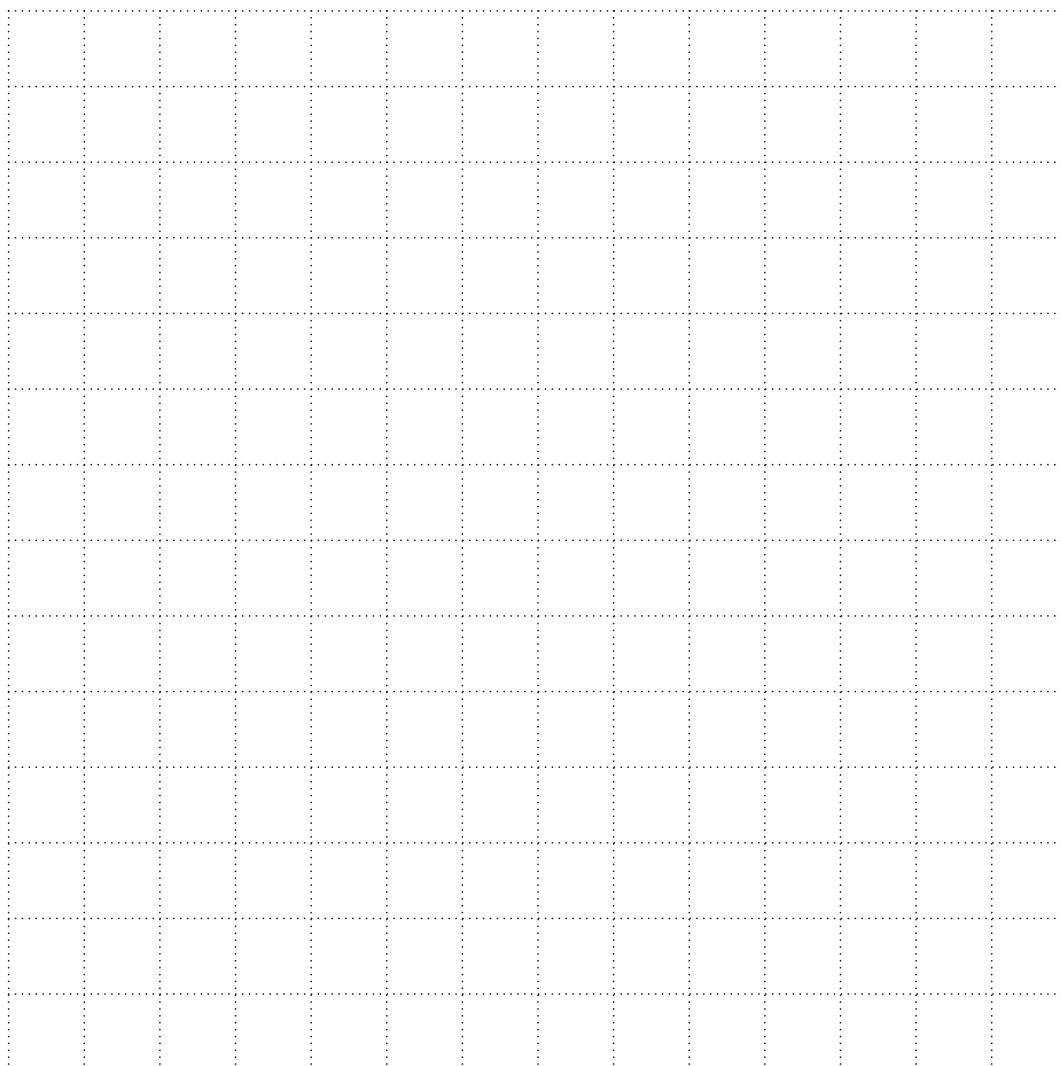
Answer \$..... [2]

- (b) The rate of exchange between pounds (£) and dollars is $\text{£}1 = \$1.87$.
The rate of exchange between pounds (£) and euros (€) is $\text{£}1 = \text{€} x$.
Rose changed \$850 and received €550 .

Calculate x .

Answer $x =$ [3]

- 2 A is the point $(8, 7)$, B is the point $(-2, 11)$ and C is the point $(1, 7)$.



- (a) Calculate the area of triangle ABC .

Answer units² [2]

(b) Calculate the length of AB .

Answer units [2]

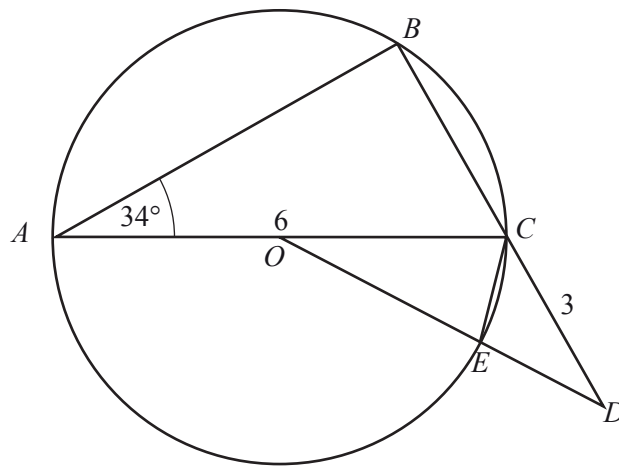
(c) Calculate the perimeter of triangle ABC .

Answer units [2]

(d) Calculate $\hat{BAC}$.

Answer [2]

3 (a)



AC is a diameter of the circle, centre O .
 BCD and OED are straight lines.
 $AC = 6$ cm and $CD = 3$ cm.
 $\hat{BAC} = 34^\circ$.

(i) Explain why $\hat{BCA} = 56^\circ$.

[1]

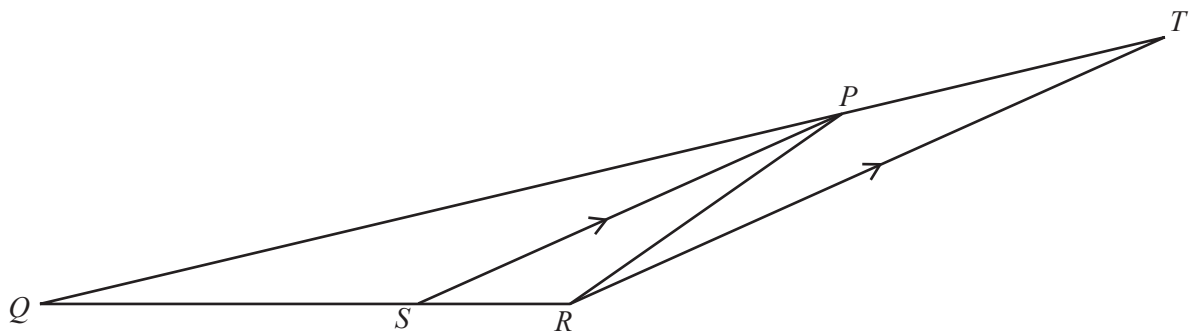
(ii) Find $\hat{COD}$.

Answer [2]

(iii) Find $\hat{OCE}$.

Answer [1]

(b)

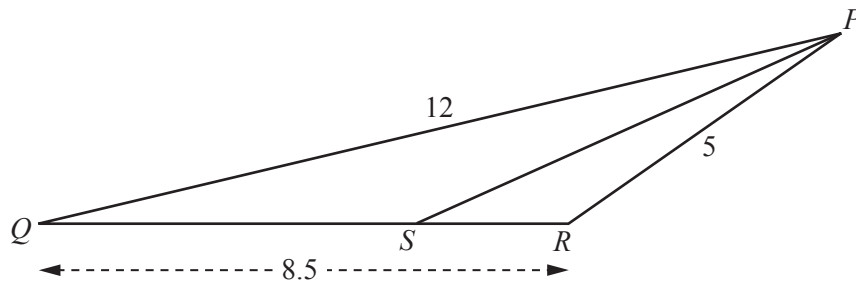


In the diagram, PS is the bisector of $\angle P$.
 QPT and QSR are straight lines.
 RT is parallel to SP .

(i) Explain why $PT = PR$.

[2]

(ii) This diagram shows part of the above diagram.
 $PQ = 12$ cm, $PR = 5$ cm and $QR = 8.5$ cm.



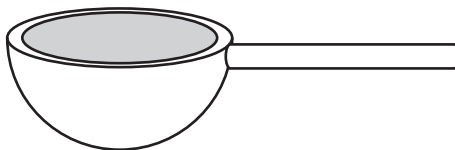
It is given that $\frac{PQ}{PR} = \frac{QS}{SR}$.

Find SR .

Answer cm [3]

4 [The volume of a sphere is $\frac{4}{3}\pi r^3$]

(a)



A spoon used for measuring in cookery consists of a hemispherical bowl and a handle.
The internal volume of the hemispherical bowl is 20 cm^3 .
The handle is of length 5 cm.

(i) Find the internal radius of the hemispherical bowl.

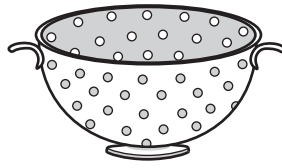
Answer cm [2]

(ii) The hemispherical bowl of a geometrically similar spoon has an internal volume of 50 cm^3 .

Find the length of its handle.

Answer cm [2]

(b) [The surface area of a sphere is $4\pi r^2$]



An open hemisphere of radius 5.5 cm is used to make a metal kitchen strainer.

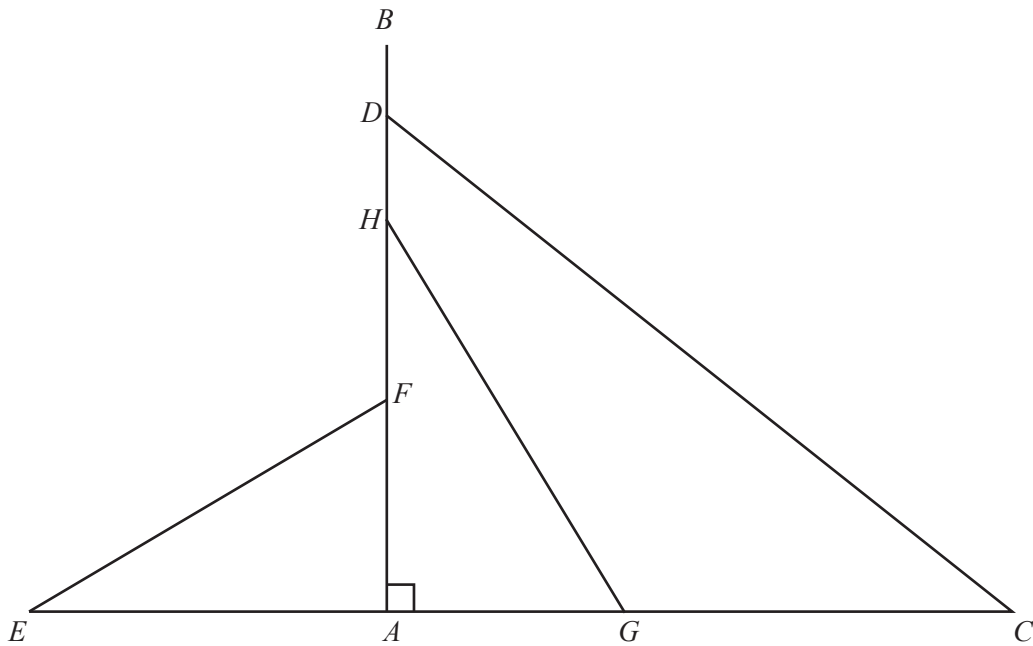
50 holes are cut out of the curved surface.

Assume that the piece of metal removed to make each hole is a circle of radius 1.5 mm.

Calculate the external surface area that remains.

Answer cm^2 [3]

5



The diagram shows a vertical radio mast, AB .

Three of the wires that hold the mast in place are attached to it at F , H and D .

The base A of the mast, and the ends E , G and C of the wires are in a straight line on horizontal ground.

- (a) The wire CD has length 65 m.
It is attached to the mast at D where $AD = 40$ m.

Calculate AC .

Answer m [2]

- (b) The wire EF makes an angle of 25° with the horizontal and is of length 30 m.

Calculate AF .

Answer m [2]

- (c) $AH = 35$ m.

The wire HG makes an angle of 30° with the mast AB .

Calculate HG .

Answer m [3]

- 6 (a) (i) Solve the equation $\left(x + \frac{7}{2}\right) = \pm \frac{\sqrt{5}}{2}$.

Give both answers correct to 2 decimal places.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [2]

- (ii) The solutions of $\left(x + \frac{7}{2}\right) = \pm \frac{\sqrt{5}}{2}$ are also the solutions of $x^2 + Bx + C = 0$,
where B and C are integers.

Find B and C .

Answer $B = \dots\dots\dots$ $C = \dots\dots\dots$ [3]

- (b) Solve the inequality $7 - 3x > 13$.

Answer $x \dots\dots\dots$ [2]

(c) Factorise $6x - 3yt + 18y - xt$.

Answer [2]

(d) Solve these simultaneous equations.

$$\begin{aligned}3a + 4b &= -13 \\5a + 6b &= -11\end{aligned}$$

Answer $a =$

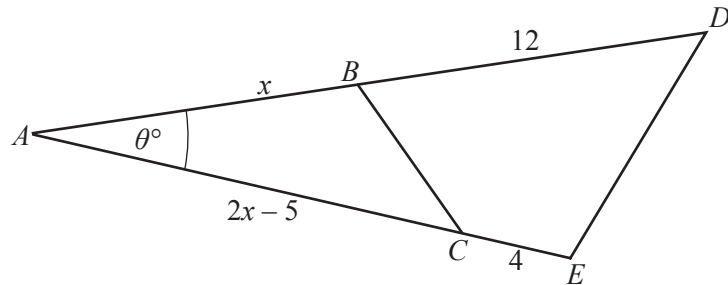
$b =$ [4]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

7



ABD and ACE are straight lines.

$BD = 12$ cm and $CE = 4$ cm.

$AB = x$ cm and $AC = (2x - 5)$ cm.

Angle $BAC = \theta^\circ$.

- (a) Show that $\frac{\text{area of triangle } ABC}{\text{area of triangle } ADE} = \frac{AB \times AC}{AD \times AE}$.

[2]

- (b) It is given that $\frac{\text{area of triangle } ABC}{\text{area of triangle } ADE} = \frac{1}{3}$.

Using the result from part (a), form an equation in x and show that it simplifies to $2x^2 - 19x + 6 = 0$.

[3]

- (c) (i) Solve the equation $2x^2 - 19x + 6 = 0$, giving your answers correct to 2 decimal places.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (ii) State, with a reason, which of these solutions does **not** apply to triangle ABC .

Answer $\dots\dots\dots$ [1]

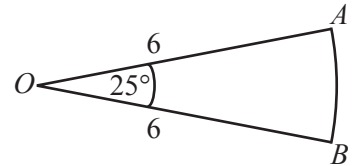
- (d) Given that $\theta = 25$, calculate BC .

Answer $\dots\dots\dots$ cm [3]

- 8 (a) OAB is a sector of a circle, centre O , radius 6 cm.

$$\angle AOB = 25^\circ.$$

- (i) Calculate the length of the arc AB .



Answer cm [2]

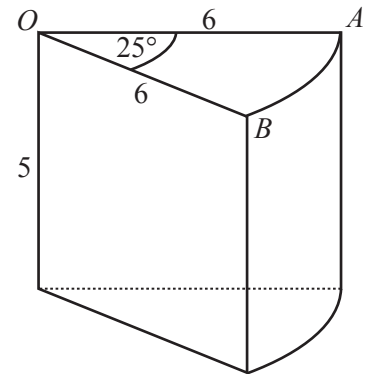
- (ii) Calculate the area of the sector OAB .

Answer cm^2 [2]

- (b) The sector OAB from part (a) is the cross-section of a slice of cheese.

The slice has a height of 5 cm.

- (i) Calculate the volume of this slice of cheese.



Answer cm^3 [1]

- (ii) Calculate the total surface area of this slice of cheese.

Answer cm^2 [3]

- (iii) Another 25° slice of cheese has 3 times the height and twice the radius.

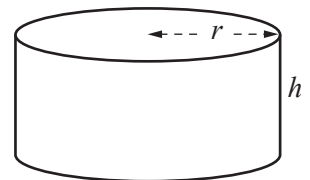
Calculate its volume.

Answer cm^3 [2]

- (c) A dairy produces cylindrical cheeses, each with a volume of 800 cm^3 .

The height h cm and the radius r cm can vary.

- (i) Express h in terms of r .



Answer [1]

- (ii) What happens to the height if the radius is doubled?

Answer [1]

- 9 The distance, d metres, of a moving object from an observer after t minutes is given by

$$d = t^2 + \frac{48}{t} - 20.$$

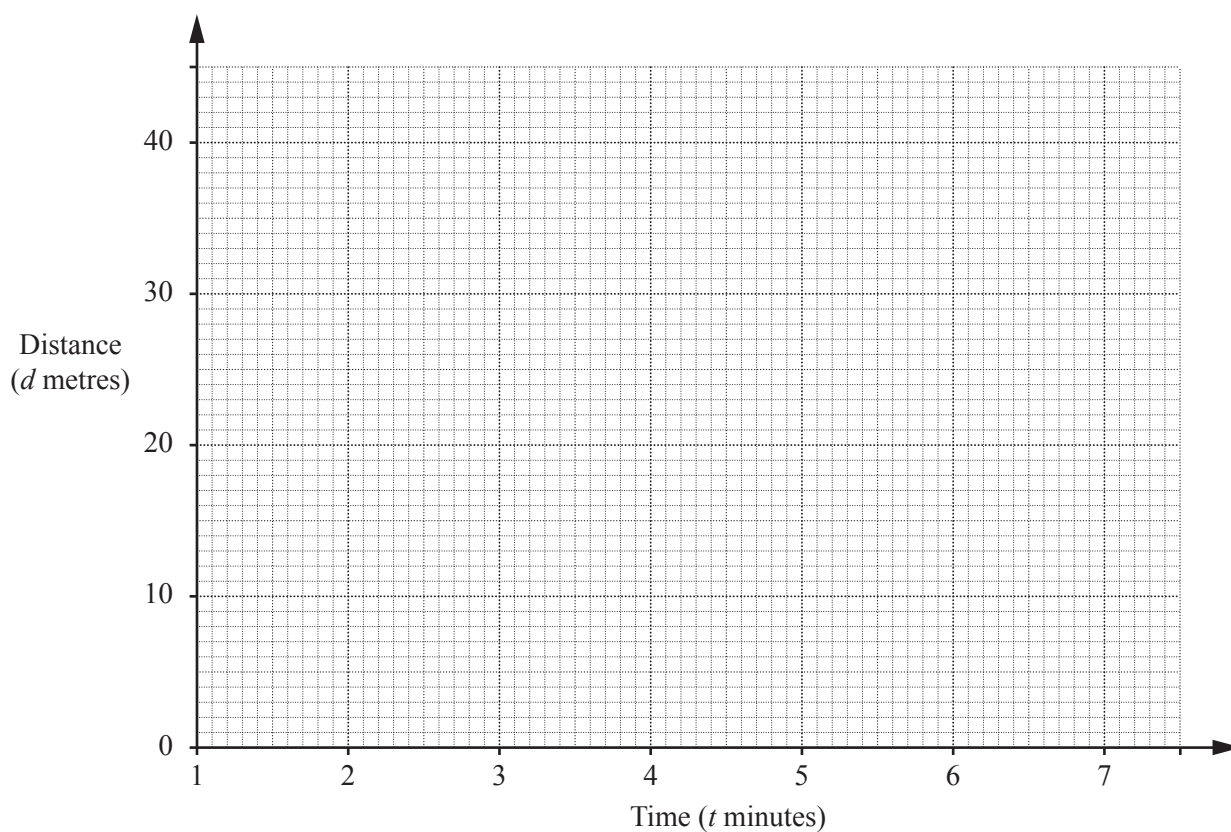
- (a) Some values of t and d are given in the table.
The values of d are given to the nearest whole number where appropriate.

t	1	1.5	2	2.5	3	3.5	4	4.5	5	6	7
d	29	14	8	5	5	6	8	11	15	24	

Complete the table.

[1]

- (b) On the grid, plot the points given in the table and join them with a smooth curve.



[2]

- (c) (i) By drawing a tangent, calculate the gradient of the curve when $t = 4$.

Answer [2]

- (ii) Explain what this gradient represents.

Answer [1]

- (d) For how long is the object less than 10 metres from the observer?

Answer minutes [2]

- (e) (i) Using your graph, write down the two values of t when the object is 12 metres from the observer.

For each value of t , state whether the object is moving towards or away from the observer.

Answer When $t =$, the object is moving the observer.

When $t =$, the object is moving the observer. [2]

- (ii) Write down the equation that gives the values of t when the object is 12 metres from the observer.

Answer [1]

- (iii) This equation is equivalent to $t^3 + At + 48 = 0$.

Find A .

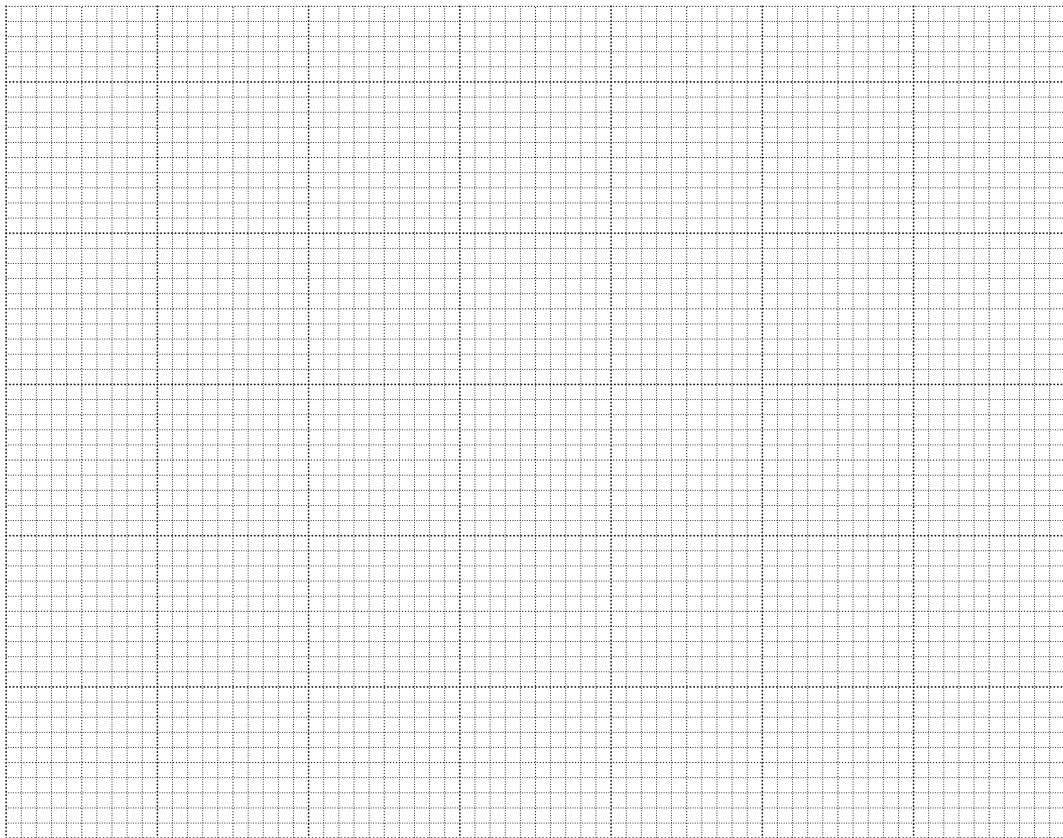
Answer $A =$ [1]

- 10** The length of time taken by 80 drivers to complete a particular journey is summarised in the table below.

Time (t minutes)	$60 < t \leq 80$	$80 < t \leq 90$	$90 < t \leq 95$	$95 < t \leq 100$	$100 < t \leq 110$	$110 < t \leq 130$
Number of drivers	4	10	14	20	24	8

- (a)** Using a scale of 2 cm to represent 10 minutes, draw a horizontal axis for times from 60 minutes to 130 minutes.

Choose a suitable scale for the vertical axis and draw a histogram to represent this information.



[3]

- (b) In which of the intervals does the median time lie?

Answer [1]

- (c) Calculate an estimate of the mean time taken to complete the journey.

Answer minutes [3]

- (d) One driver is chosen at random.

Calculate the probability that this driver took 95 minutes or less for the journey.

Answer [1]

- (e) Two of the 80 drivers are chosen at random.

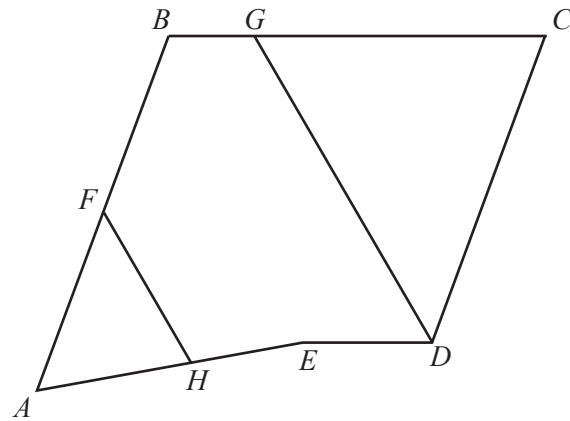
- (i) Calculate the probability that both took more than 100 minutes for the journey.

Answer [2]

- (ii) Calculate the probability that one took 80 minutes or less and the other took more than 110 minutes.

Answer [2]

11 (a)



$ABCDE$ is a pentagon.

AFB , AHE and BGC are straight lines.

(i) $\vec{AE} = \begin{pmatrix} 6 \\ 1 \end{pmatrix}$.

Calculate $|\vec{AE}|$.

Answer units [1]

(ii) H is the midpoint of AE , and $\vec{FH} = \begin{pmatrix} 2 \\ -3.5 \end{pmatrix}$.

Find $\vec{AF}$.

Answer [2]

- (iii) G divides BC in the ratio $1 : 2$.

$$\overrightarrow{BG} = \begin{pmatrix} 2.5 \\ 0 \end{pmatrix} \text{ and } \overrightarrow{CD} = \begin{pmatrix} -1 \\ -7 \end{pmatrix}.$$

- (a) Find $\overrightarrow{GD}$.

Answer [1]

- (b) Explain why GD is parallel to FH .

[1]

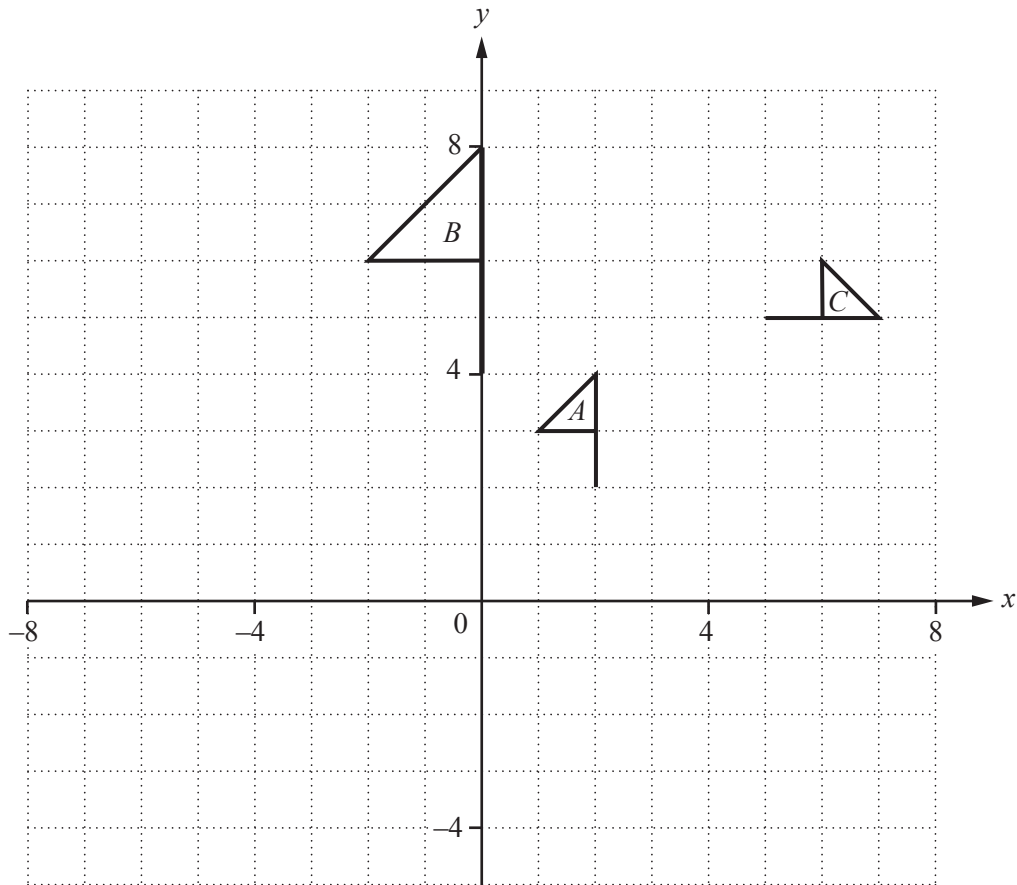
- (iv) B is the point $(3, 10)$.

Find the coordinates of D .

Answer (.....,) [1]

Question 11(b) is printed on the next page

(b)



- (i) Flag A is mapped onto flag T by the translation $\begin{pmatrix} -3 \\ -6 \end{pmatrix}$.

Draw, and label, flag T .

[1]

- (ii) Describe fully the enlargement that will map flag A onto flag B .

Answer [2]

- (iii) Find the centre of the rotation that will map flag A onto flag C .

Answer (.....,) [1]

- (iv) Rotate flag B through 45° anticlockwise about the origin.
Label the image R .

[2]

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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

October/November 2016

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **23** printed pages and **1** blank page.

Section A [52 marks]

Answer **all** the questions in this section.

1 (a) In 2016, the price of a television is \$1995.

(i) Afzal pays the \$1995 with a deposit of \$399 and 12 equal monthly payments.

Calculate Afzal's monthly payment.

Answer \$ [1]

(ii) What percentage of \$1995 is \$399?

Answer % [1]

(iii) The price of the television in 2016 is 5% more than the price in 2015.

Calculate the price in 2015.

Answer \$ [2]

- (b) Afzal watched a programme that lasted 2 hours 53 minutes.
It ended at 01 15.

At what time did it start?

Answer [1]

- (c) A company paid a quarter of a million dollars for an advertisement that lasted 38 seconds.

Calculate the cost, correct to the nearest hundred dollars, for each second of the advertisement.

Answer \$ [2]

- (d) The programme showed an athlete running 100 metres, measured correct to the nearest metre.
The time the athlete took was 11.3 seconds, measured correct to the nearest 0.1 second.

Calculate the upper bound of the athlete's average speed.

Answer m/s [2]

2 (a) Evaluate $\sqrt[3]{\frac{543}{28.6 - 1.35}}$.

Answer [1]

(b) Factorise completely $9p^2 - 6pq$.

Answer [1]

(c) Expand the brackets and simplify $(3a + b)^2$.

Answer [1]

(d) Express as a single fraction in its simplest form $\frac{4}{2t+1} - \frac{3}{3t+1}$.

Answer [3]

- (e) Find the integer values of n such that

$$4(2 - n) > 17 \text{ and}$$

$$n > -6.$$

Answer [2]

- (f) Abebi, Bella and Chuku share \$112.

Abebi receives \$ x .

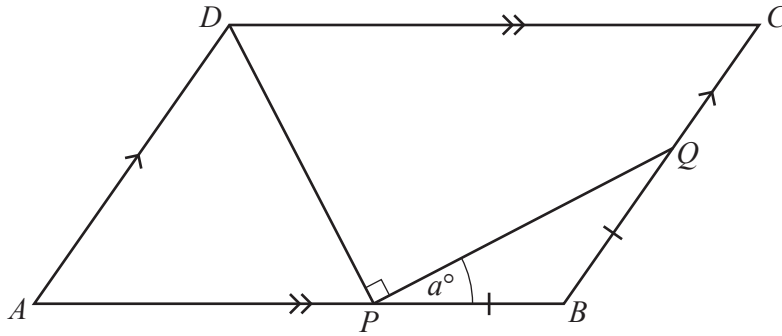
Bella receives \$12 less than Abebi.

Chuku receives twice as much as Bella.

Form an equation in x and solve it to find how much Chuku receives.

Answer \$ [3]

3



In the diagram, $ABCD$ is a parallelogram.

P and Q are points on AB and BC respectively, such that $PB = BQ$ and $\hat{DPQ} = 90^\circ$.
 $\hat{BPQ} = a^\circ$.

- (a) Find an expression, in terms of a , for each of the following angles.
 Give each answer in its simplest form.

(i) $\hat{PBQ}$

Answer [1]

(ii) $\hat{APD}$

Answer [1]

(iii) $\hat{DAP}$

Answer [1]

(iv) $\hat{ADP}$

Answer [1]

(b) $AB = 8$ cm and $AD = 4.7$ cm.

(i) Find PB .

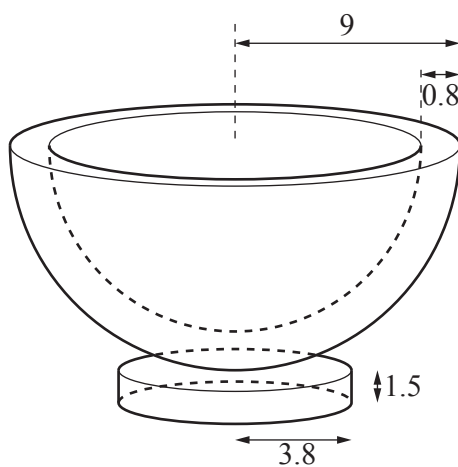
Answer cm [1]

(ii) Given also that $\hat{DAB} = 54^\circ$, calculate the area of the parallelogram.

Answer cm² [2]

4 [The volume of a sphere is $\frac{4}{3}\pi r^3$]

[The surface area of a sphere is $4\pi r^2$]



A hemispherical bowl is made of material that is 0.8 cm thick.

The outside rim of the bowl has radius 9 cm.

The bowl is attached to a base which is a solid cylinder, of radius 3.8 cm and height 1.5 cm.

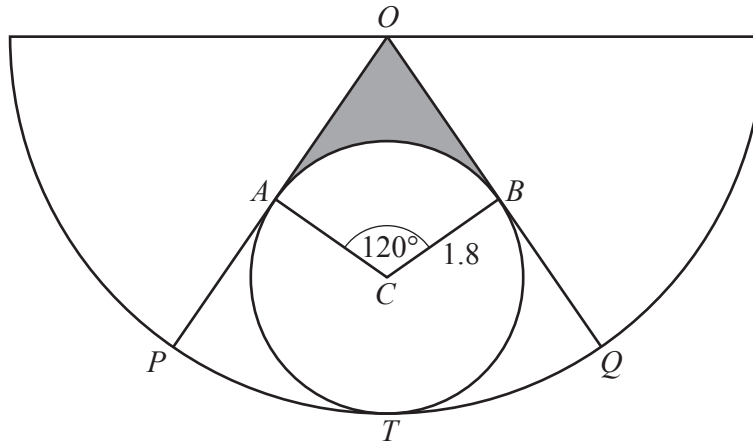
(a) Calculate the surface area of the **inside** of the hemispherical bowl.

Answer cm² [2]

- (b) Calculate the **total** volume of material used to make the bowl and the base.

Answer cm³ [5]

5



The diagram shows a semicircle with radii OP and OQ drawn.
 The circle, centre C , touches the radii at A and B and the semicircle at T .
 The radius of the circle is 1.8 cm.
 $\hat{BCA} = 120^\circ$.

- (a) Calculate the length of the minor arc AB .

Answer cm [2]

- (b) The shaded region lies between the circle and the radii OP and OQ .

Calculate the perimeter of this shaded region.

Answer cm [3]

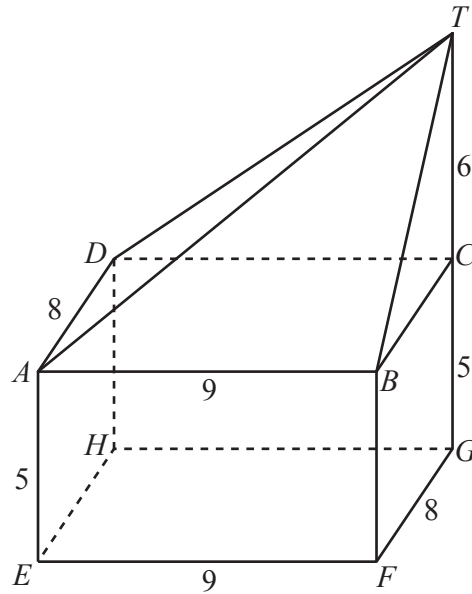
- (c) (i) Show that the radius of the semicircle is 5.4 cm.

[2]

- (ii) Calculate the length of BQ .

Answer cm [1]

6



The four walls of a building are faces of a cuboid $ABCDEFGH$.
 T is vertically above C and G , so $\hat{ABT} = \hat{ADT} = 90^\circ$.

The cuboid has length 9 m, width 8 m and height 5 m.
 $TC = 6$ m.

(a) Calculate the length of DT .

Answer m [2]

(b) The roof is formed by four triangles, ABT , BCT , CDT and DAT .

Calculate the **total** surface area of the roof.

Answer m^2 [3]

- (c) [The volume of a pyramid is $\frac{1}{3} \times \text{area of base} \times \text{perpendicular height}$]

Calculate the **total** volume of the building.

Answer m³ [2]

- (d) Calculate the angle of elevation of T from H .

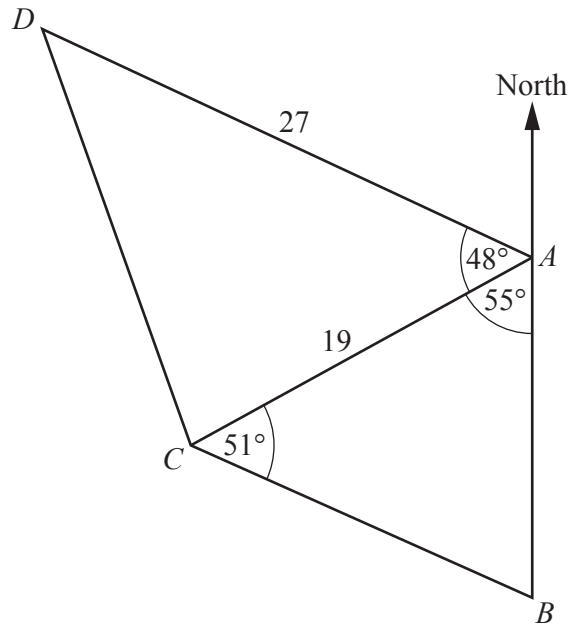
Answer [3]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

7



The diagram shows the positions of four islands at A , B , C and D .

A is due north of B .

$\hat{D}AC = 48^\circ$, $\hat{C}AB = 55^\circ$ and $\hat{B}CA = 51^\circ$.

$AC = 19\text{ km}$ and $AD = 27\text{ km}$.

(a) Calculate the bearing of D from A .

Answer [1]

(b) Calculate the bearing of A from C .

Answer [1]

(c) Calculate the distance between A and B .

Answer km [3]

- (d) Calculate the distance between D and C .

Answer km [3]

- (e) A boat leaves D and sails, at a constant speed, in a straight line to A .
It takes 3 hours and 36 minutes to sail from D to A .
 X is the point on DA that is closest to C .

Calculate the time, correct to the nearest minute, the boat takes to travel from D to X .

Answer [4]

8

$$y = \frac{3}{5} \times 2^x$$

The table shows some values of x and the corresponding values of y , correct to one decimal place where necessary.

x	-1.5	-1	0	1	2	2.5	3	3.5	4
y	p	0.3	0.6	1.2	2.4	3.4	4.8	6.8	9.6

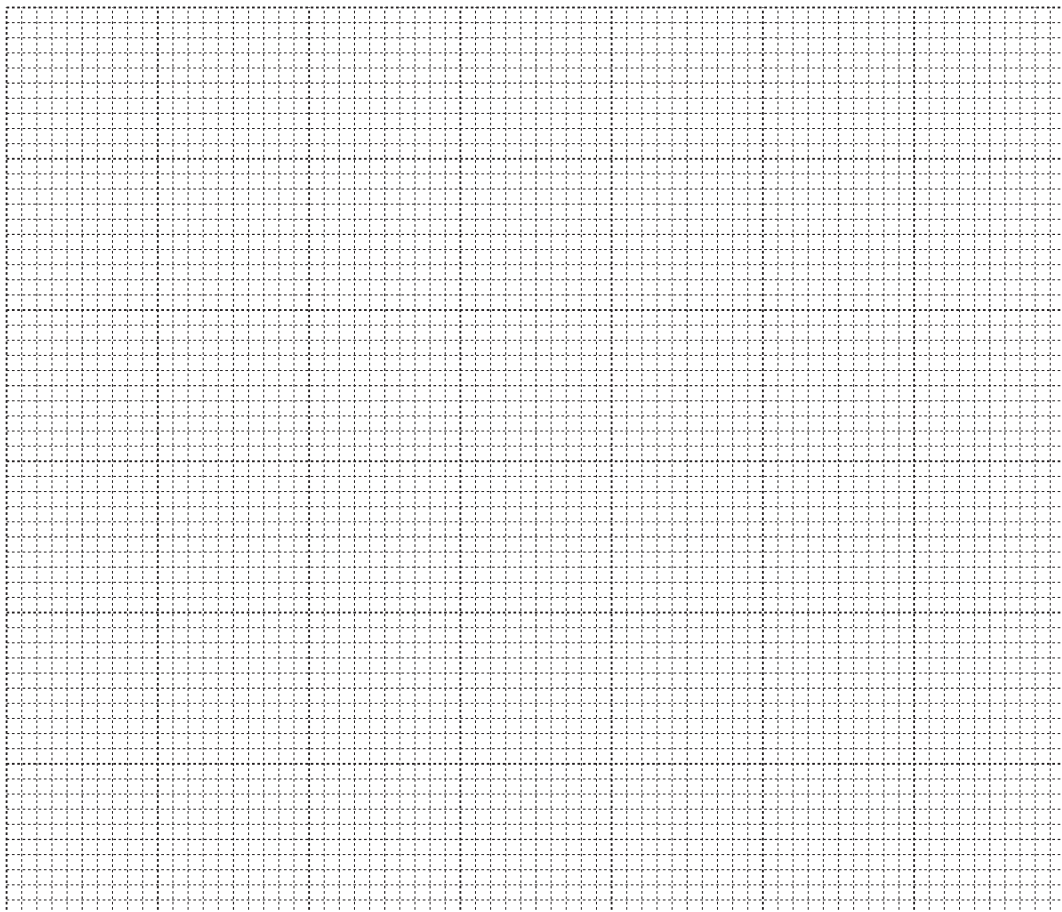
(a) Calculate p .

Answer [1]

(b) On the grid,

- using a scale of 2 cm to 1 unit, draw a horizontal x -axis for $-2 \leq x \leq 4$,
- using a scale of 1 cm to 1 unit, draw a vertical y -axis for $0 \leq y \leq 10$,
- plot the points from the table and join them with a smooth curve.

[3]



- (c) By drawing a tangent, estimate the gradient of the curve at the point where $x = 2.5$.

Answer [2]

- (d) (i) On the same grid, draw the straight line that passes through $(-0.4, 0)$ and $(2, 3.6)$.

[1]

- (ii) Find the equation of this line in the form $y = mx + c$.

Answer [2]

- (iii) Write down the x -coordinates of the points where the line intersects the curve.

Answer $x =$ and $x =$ [1]

- (iv) These x -coordinates satisfy the equation

$$2^x = Ax + B.$$

Find the values of A and B .

Answer $A =$ $B =$ [2]

9 On Monday, Abdul sold 140 boxes of matches at 30 cents per box.

(a) Calculate the income, in dollars, Abdul received on Monday.

Answer \$ [1]

(b) On Tuesday, the price per box decreased by 10% and the number of boxes sold increased by 30%.

Calculate the percentage change in the income.

Answer % [3]

(c) On Wednesday, the price of a box was y cents less than it was on Monday.

Abdul sold $4y$ more boxes on Wednesday than he did on Monday.

(i) Write down an expression, in terms of y , for the income received on Wednesday.
Give your answer in dollars.

Answer \$ [2]

- (ii) Given that this income is equal to \$40, write down an equation in y and show that it simplifies to

$$y^2 + 5y - 50 = 0.$$

[2]

- (iii) Solve the equation $y^2 + 5y - 50 = 0$.

Answer $y = \dots\dots\dots$ or $\dots\dots\dots$ [3]

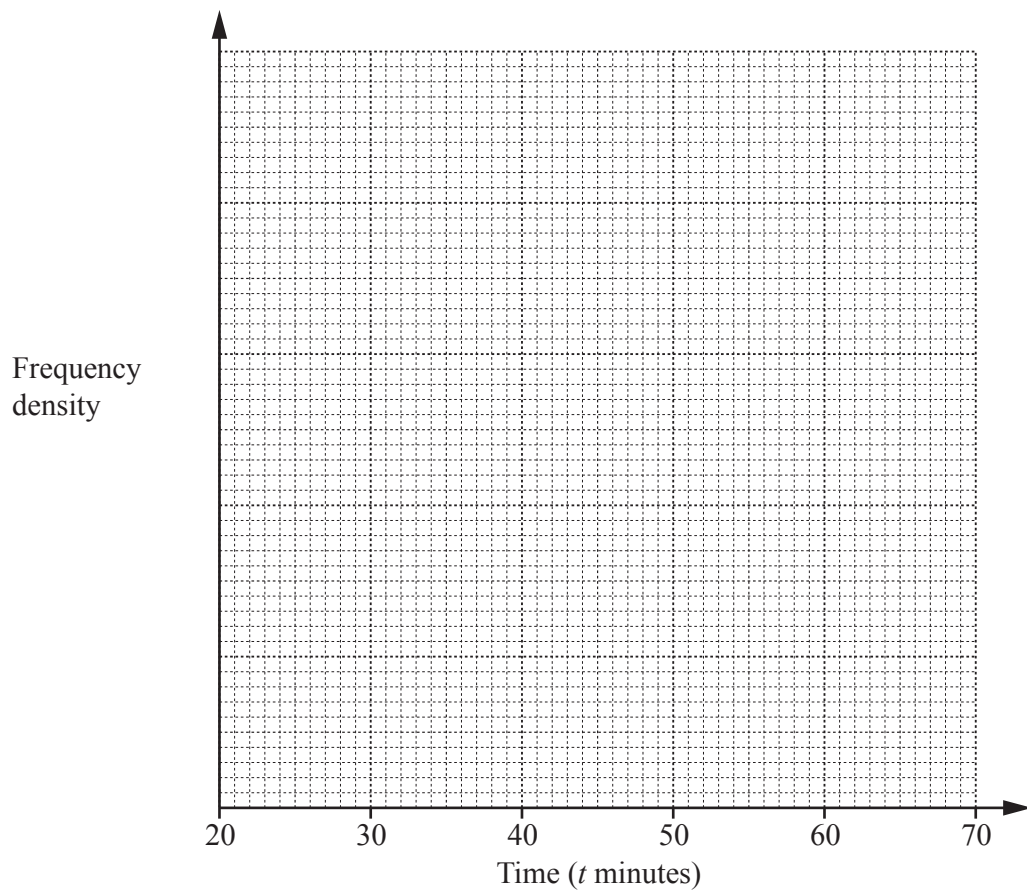
- (iv) Hence find the number of boxes sold on Wednesday.

Answer $\dots\dots\dots$ [1]

- 10 (a) The times taken by 135 runners to complete a cross-country course were recorded. The results are summarised in the table.

Time (t minutes)	$20 < t \leq 30$	$30 < t \leq 35$	$35 < t \leq 40$	$40 < t \leq 50$	$50 < t \leq 70$
Number of runners	15	30	40	35	15

- (i) On the grid, draw a histogram to represent this information.

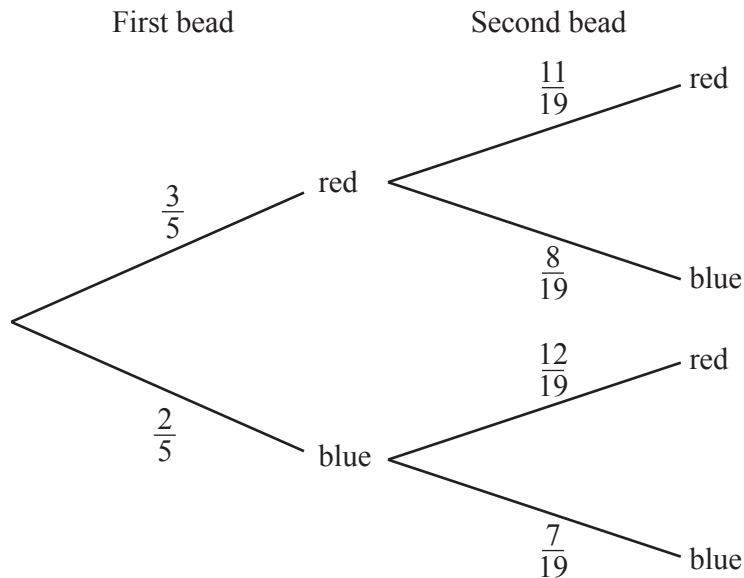


[3]

- (ii) Calculate an estimate of the mean time.

Answer minutes [3]

- (b) A bag contains R red beads and B blue beads.
Two beads are chosen, at random, without replacement.
The tree diagram shows the possible outcomes and their probabilities.



- (i) Calculate the probability that both beads are red.

Answer [1]

- (ii) Calculate the probability that the two beads are different colours.

Answer [2]

- (iii) What is the value of R ?

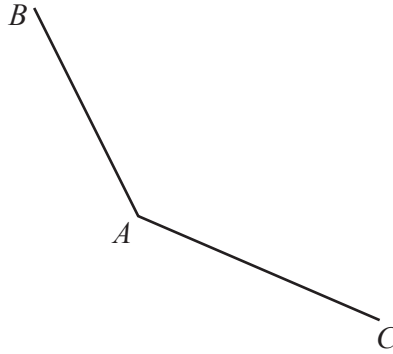
Answer [1]

- (iv) Of the red beads, half have a yellow spot.

Calculate the probability that, of the two chosen beads, **neither** has a yellow spot.

Answer [2]

11 (a)



In the diagram, $\overrightarrow{AB} = \begin{pmatrix} -6 \\ 11 \end{pmatrix}$, $\overrightarrow{AC} = \begin{pmatrix} 12 \\ -5 \end{pmatrix}$.

(i) Find $|\overrightarrow{AC}|$.

Answer [2]

(ii) D is the point such that $\overrightarrow{AD} = \begin{pmatrix} 0 \\ k \end{pmatrix}$, where $k > 0$.

BD is parallel to AC .

(a) Show that $\overrightarrow{BD} = \begin{pmatrix} 6 \\ k - 11 \end{pmatrix}$.

[1]

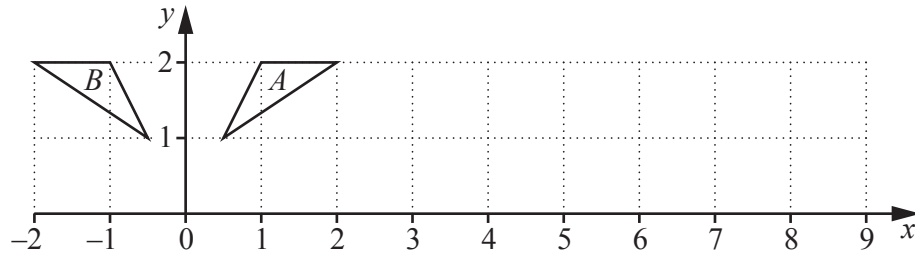
(b) Find k .

Answer $k =$ [2]

(c) Find the difference between the lengths of AD and AC .

Answer [1]

(b)



Triangle A has vertices $(\frac{1}{2}, 1)$, $(1, 2)$ and $(2, 2)$.

Triangle B has vertices $(-\frac{1}{2}, 1)$, $(-1, 2)$ and $(-2, 2)$.

- (i) Describe fully the **single** transformation that maps triangle A onto triangle B .

Answer [2]

- (ii) Triangle A is mapped onto triangle C by a transformation represented by the matrix $\begin{pmatrix} 1 & 3 \\ 0 & 1 \end{pmatrix}$.

- (a) Calculate the coordinates of the vertices of triangle C .

Answer (..... ,) (..... ,) (..... ,) [2]

- (b) Find the matrix which represents the transformation that maps triangle B onto triangle C .

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

October/November 2016

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **23** printed pages and **1** blank page.

Section A [52 marks]

Answer **all** questions in this section.

- 1** The basic price of the 2016 model of a car is \$21 000.
Sayeed and Rasheed each buy this model of car.

- (a) (i)** Sayeed pays a deposit of \$756.

Calculate the deposit Sayeed pays as a percentage of the basic price.

Answer % [1]

- (ii)** He then pays 24 monthly payments of \$922.25 .

Calculate the **total** amount that Sayeed pays as a percentage of the basic price.

Answer % [2]

- (b) Rasheed pays a deposit of \$381 followed by 36 equal monthly payments. The **total** amount that he pays is 127% of the basic price of \$21 000.

Calculate Rasheed's monthly payment.

Answer \$ [3]

- (c) \$21 000 represented an increase of 5% on the basic price of the 2015 model.

Calculate the difference between the basic prices of the 2015 and 2016 models.

Answer \$ [3]

2 (a) Simplify $\frac{3a^2}{10bc} \div \frac{9a}{5b^2c}$.

Answer [2]

(b) Simplify $\frac{h-k}{5h-5k}$.

Answer [2]

(c) Factorise $9m^2 - 4n^2$.

Answer [1]

(d) Factorise $q(p - 2) + 3(2 - p)$.

Answer [2]

(e) (i) Find the two solutions of $5x - 1 = \pm 9$.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [2]

(ii) The solutions of $5x - 1 = \pm 9$ are also the solutions of $5x^2 + Bx + C = 0$, where B and C are integers.

Find B and C .

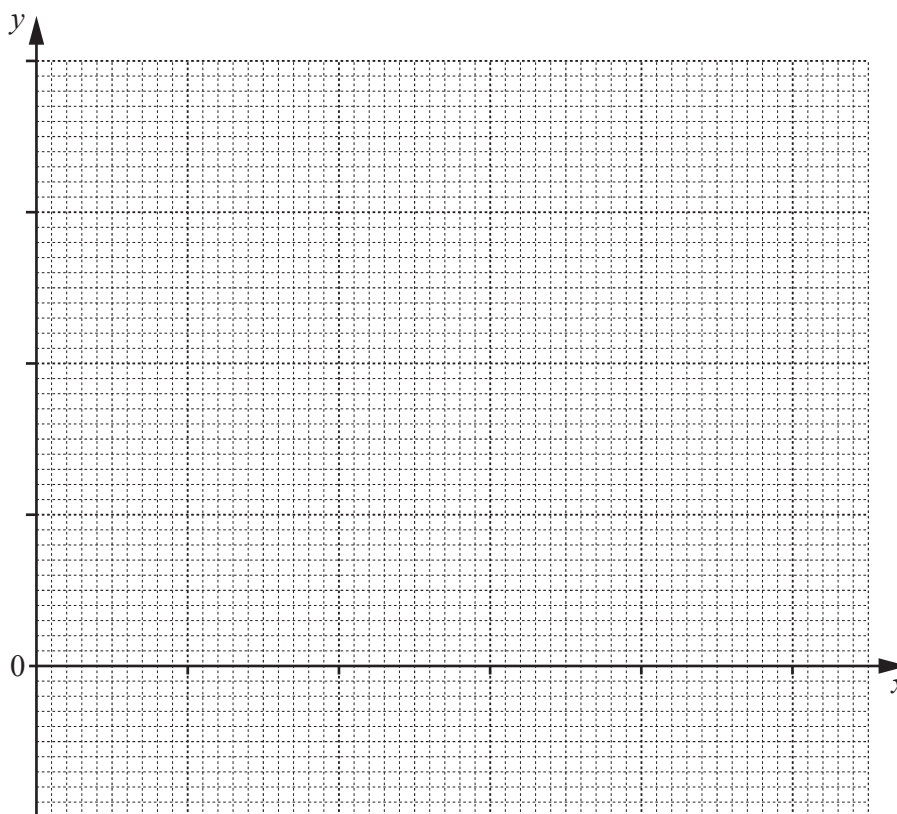
Answer $B = \dots\dots\dots$, $C = \dots\dots\dots$ [2]

- 3 (a) Complete the table of values for $y = \frac{x}{20}(x^2 - 10)$.

x	0	1	2	3	4	5
y	0	-0.45	-0.6	-0.15	1.2	

[1]

- (b) Using a scale of 2 cm to 1 unit on both axes, draw the graph of $y = \frac{x}{20}(x^2 - 10)$ for $0 \leq x \leq 5$.



[2]

- (c) By drawing a tangent, estimate the gradient of the curve at the point where $x = 2.5$.

Answer [2]

- (d) Use your graph to solve the equation $\frac{x}{20}(x^2 - 10) = 0$ for $0 \leq x \leq 5$.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [2]

- (e) The graph of $y = \frac{x}{20}(x^2 - 10)$, together with the graph of a straight line L , can be used to solve the equation $x^3 + 10x - 80 = 0$ for $0 \leq x \leq 5$.

- (i) Find the equation of line L .

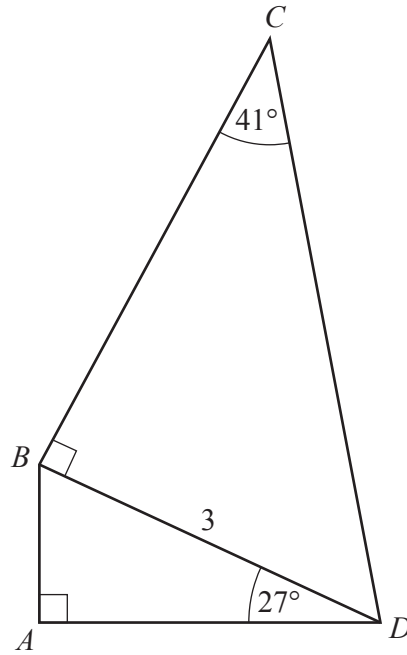
Answer $\dots\dots\dots$ [2]

- (ii) Draw the graph of line L on the grid. [1]

- (iii) Hence solve the equation $x^3 + 10x - 80 = 0$ for $0 \leq x \leq 5$.

Answer $x = \dots\dots\dots$ [1]

4 (a)



In the framework $ABCD$, $BD = 3$ m.
 $\hat{BDA} = 27^\circ$, $\hat{BCD} = 41^\circ$. $\hat{DBC}$ and $\hat{DAB}$ are right angles.

(i) Find AD .

Answer m [2]

(ii) Find CD .

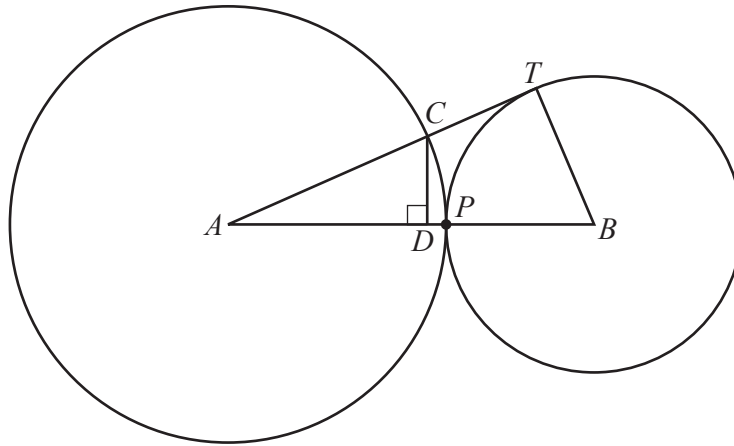
Answer m [3]

- (b) In triangle PQR , $PQ = 3$ m and $QR = 5$ m.
The area of triangle $PQR = 6 \text{ m}^2$.

Find the two possible values of $\hat{PQR}$.

Answer $\hat{PQR} = \dots\dots\dots$ or $\dots\dots\dots$ [3]

5



In the diagram, A and B are the centres of two circles that touch at P .
 The line ACT touches the small circle at T and intersects the large circle at C .
 D is the point on AB such that $\hat{CDA} = 90^\circ$.

- (a) Complete the following, to show that triangle ACD is similar to triangle ABT .

In triangle ACD and triangle ABT

angle DAC = angle (same angle)
 angle CDA = angle (.....)
 angle ACD = angle (two angles in a triangle are equal,
 so the third angles are equal)

Because the three pairs of angles are equal, the triangles are similar.

[2]

- (b) Given that the radii of the circles are 7 cm and 3 cm, calculate CD .

Answer cm [3]

6 $\mathbf{A} = \begin{pmatrix} 2 & 0 \\ 3 & 1 \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} 1 & 2 \\ -1 & 3 \end{pmatrix}$

(a) Find $\mathbf{A} + 2\mathbf{B}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(b) Find $\mathbf{AB}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(c) $\mathbf{A} \begin{pmatrix} x \\ 2 \end{pmatrix} = \begin{pmatrix} 8 \\ 2y \end{pmatrix}$

Find x and y .

Answer $x = \dots\dots\dots y = \dots\dots\dots$ [2]

(d) Find $\mathbf{B}^{-1}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

7 (a) $x = \sqrt{a^2 + b^2}$

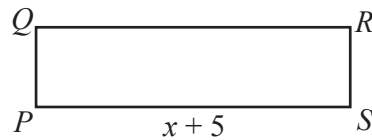
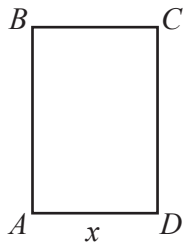
(i) Calculate x when $a = -0.73$ and $b = 1.84$.

Answer [1]

(ii) Express b in terms of x and a .

Answer $b =$ [2]

(b)



$ABCD$ and $PQRS$ are rectangles.

$AD = x$ cm and $PS = (x + 5)$ cm.

Each rectangle has an area of 17 cm^2 .

(i) Write down an expression for PQ in terms of x .

Answer $PQ =$ cm [1]

- (ii) AB is 3 cm longer than PQ .

Form an equation in x and show that it simplifies to $3x^2 + 15x - 85 = 0$.

[3]

- (iii) Solve the equation $3x^2 + 15x - 85 = 0$.
Give your solutions correct to 3 significant figures.

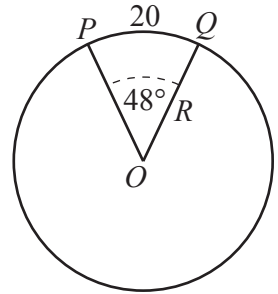
Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (iv) Find the perimeter of the rectangle $PQRS$.

Answer $\dots\dots\dots$ cm [2]

- 8 (a) P and Q are points on the circumference of a circle, centre O , radius R cm. The minor arc $PQ = 20$ cm and $\widehat{POQ} = 48^\circ$.

(i) Show that $R = 23.9$, correct to one decimal place.

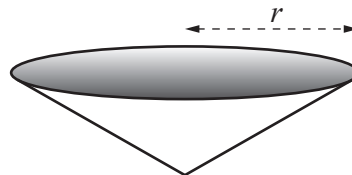
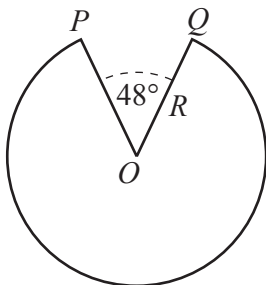


[3]

(ii) Calculate the area of the minor sector POQ .

Answer cm^2 [2]

- (iii) The minor sector POQ is removed from the circle and the remaining major sector is shaped to form an open cone of radius r cm.



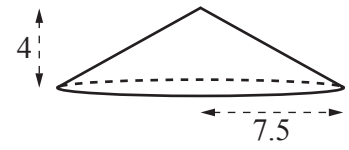
Calculate r .

Answer $r =$ [2]

(b) [The curved surface area of a cone is πrl , where l is the slant height]

Cone A has radius 7.5 cm and height 4 cm.

(i) Calculate the curved surface area of cone A.



Cone A

Answer cm^2 [3]

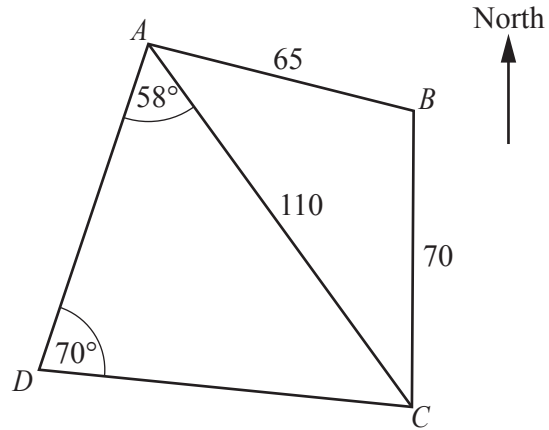
(ii) Cone B is geometrically similar to cone A.

The ratio curved surface area of cone A : curved surface area of cone B is 64 : 25 .

Find the **height** of cone B.

Answer cm [2]

9



$ABCD$ is a level playing field.

$AB = 65$ m, $BC = 70$ m and $CA = 110$ m.

$\angle CDA = 70^\circ$, $\angle DAC = 58^\circ$ and C is due South of B .

(a) Calculate the bearing of A from C .

Answer [4]

(b) Calculate AD .

Answer m [3]

(c) There are two vertical trees, AX and CY , each of height 17 m, one at each end of the path AC .

(i) Calculate the angle of elevation of Y from B .

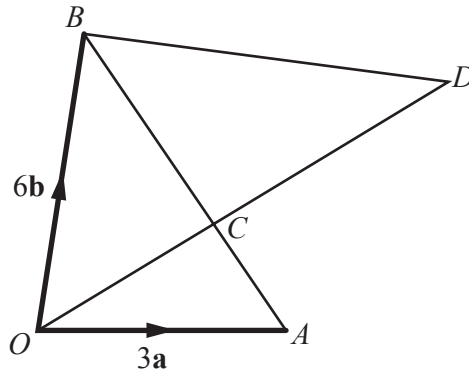
Answer [2]

(ii) A bird flies in a straight line from X to Y .
It takes 24 seconds.

Calculate the average speed of the bird.
Give your answer in kilometres per hour.

Answer km/h [3]

10 (a)



ACB and OCD are straight lines.

$AC : CB = 1 : 2$.

$\vec{OA} = 3\mathbf{a}$ and $\vec{OB} = 6\mathbf{b}$.

(i) Express $\vec{AB}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

Answer [1]

(ii) Express $\vec{AC}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

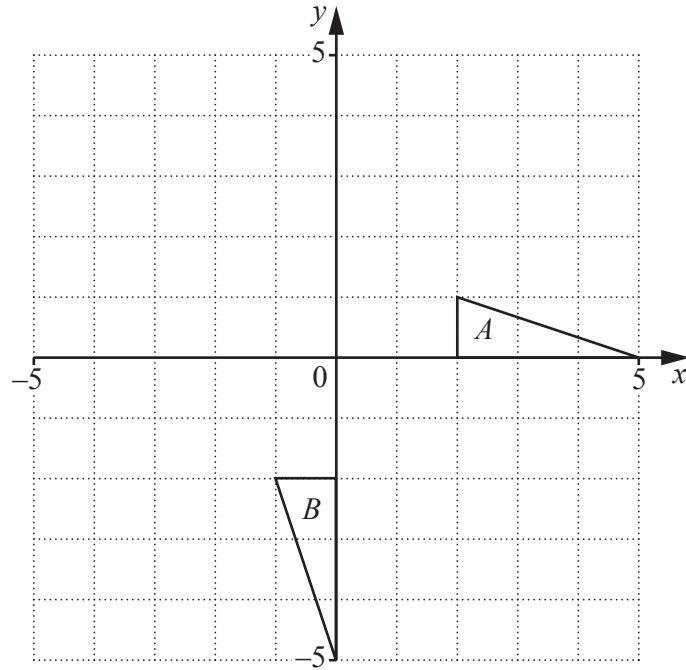
Answer [1]

(iii) $\vec{BD} = 5\mathbf{a} - \mathbf{b}$.

Showing your working clearly, find $OC : CD$.

Answer : [4]

(b)



- (i) Describe fully the **single** transformation that maps triangle A onto triangle B .

Answer [2]

- (ii) Triangle A is mapped onto triangle C by the shear H in which the y -axis is invariant, and $H(2, 1) = (2, 3)$.

- (a) On the grid, draw and label triangle C . [2]

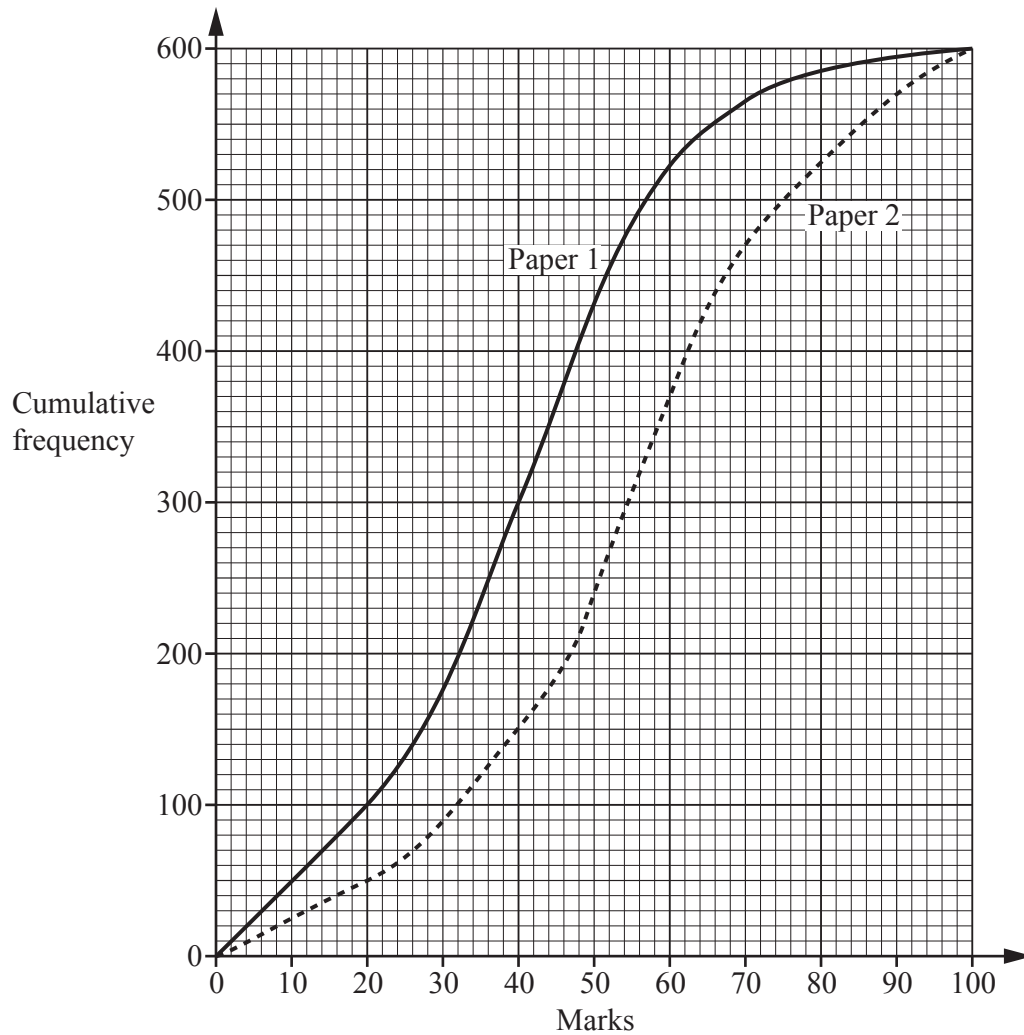
- (b) State the shear factor of H .

Answer [1]

- (c) Find the matrix that represents H .

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [1]

- 11 (a) Six hundred candidates took a mathematics examination which consisted of two papers. Each paper was marked out of 100. The diagram shows, on the same grid, the cumulative frequency curves for Paper 1 and Paper 2.



- (i) Use the cumulative frequency curve for **Paper 1** to find an estimate of

(a) the median,

Answer [1]

(b) the interquartile range,

Answer [2]

(c) the number of candidates who scored more than 45.

Answer [1]

- (ii) A candidate scored 60 on Paper 1.

Using both graphs, estimate this candidate's mark on Paper 2.

Answer [1]

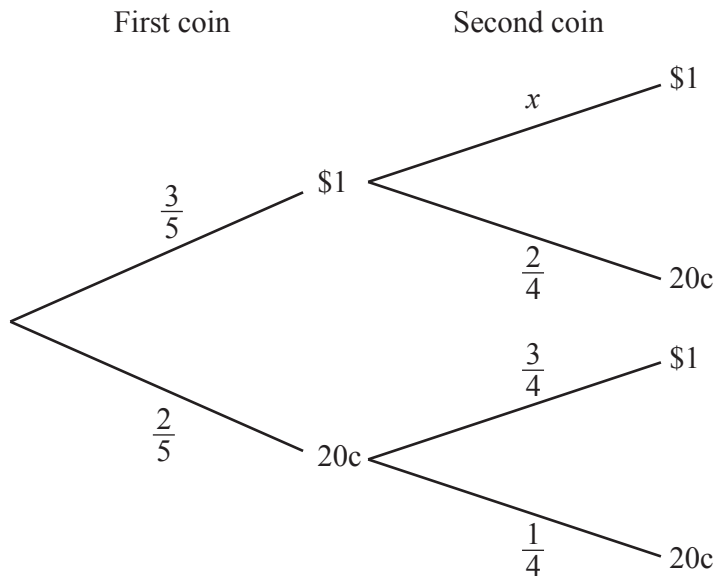
- (iii) State, with a reason, which you think was the more difficult paper.

Answer Paper because
..... [1]

Question 11(b) begins on the next page

- (b) Amira has three \$1 coins and two 20c coins in her purse. She picks out coins at random, one after the other. The coins are not replaced.

The tree diagram shows the possible outcomes and their probabilities when picking out two coins.



- (i) Find x .

Answer [1]

- (ii) Find the probability that the total value of the two coins picked out is 40 cents.

Answer [1]

- (iii) Find the probability that the total value of the two coins picked out is \$1.20 .

Answer [2]

- (iv) At a car park, the charge is \$1.40 .
Amira picks out three coins, one after the other.

Find the probability that the total value of the three coins is \$1.40 .

Answer [2]

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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

October/November 2017

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **19** printed pages and **1** blank page.

Section A [52 marks]

Answer **all** questions in this section.

- 1 (a) (i) Jasmine earns \$12.50 for each hour she works.
She works for 38 hours each week.
She is given a pay increase of 6%.

Calculate the total amount Jasmine earns each week after the pay increase.

Answer \$ [3]

- (ii) Abdul earns \$525 each week.
He moves to a new job where he earns \$462 each week.

Calculate the percentage reduction in his earnings in his new job.

Answer % [2]

- (iii) Maria is given a pay increase of 3%.
After the pay increase, she earns \$2472 each month.

Calculate her monthly pay before the pay increase.

Answer \$ [2]

- (b) The exchange rate between dollars (\$) and pounds (£) is $\$1 = \pounds 0.65$.
The exchange rate between euros (€) and pounds is $\text{€}1 = \pounds 0.74$.

Dan changes €520 into pounds.

He spends £260 and then changes the rest into dollars.

Work out how many dollars he receives.

Answer \$ [3]

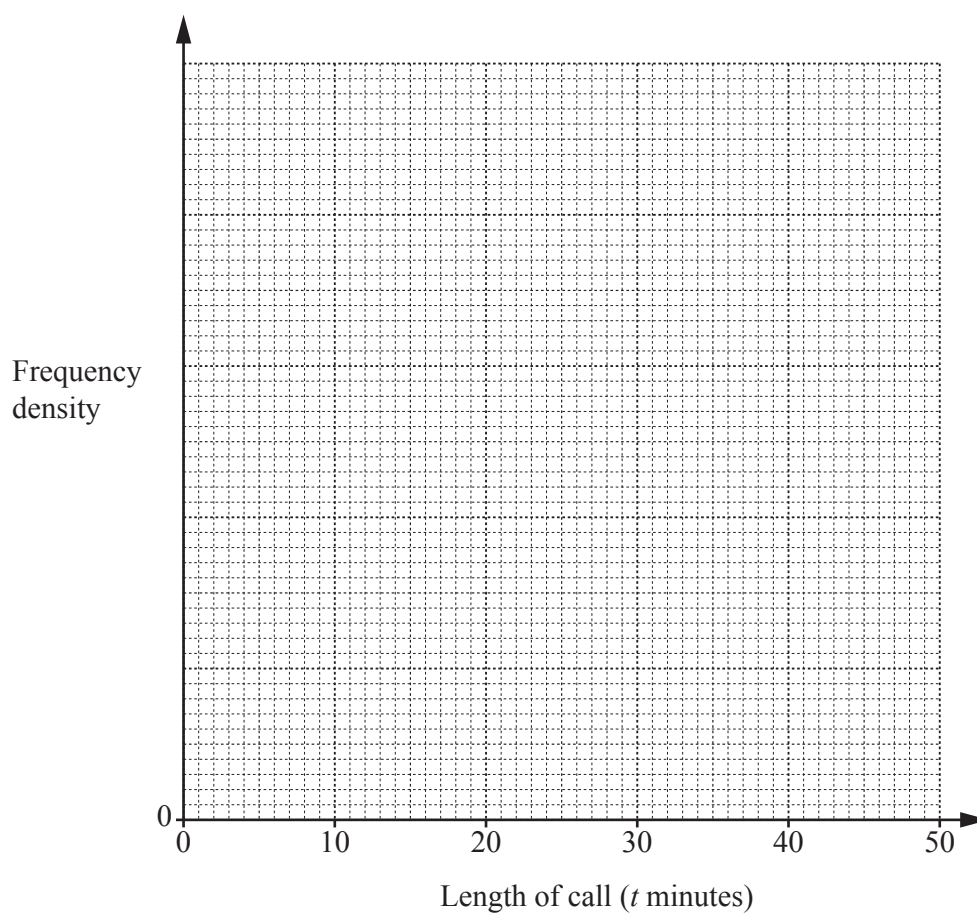
- 2 Sunil recorded the lengths, in minutes, of the 150 phone calls he made one month. His results are summarised in the table.

Length of call (t minutes)	$0 < t \leq 5$	$5 < t \leq 10$	$10 < t \leq 20$	$20 < t \leq 30$	$30 < t \leq 50$
Frequency	35	42	30	28	15

- (a) Calculate an estimate of the mean length of a call.

Answer minutes [3]

- (b) On the grid below, draw a histogram to represent this data.

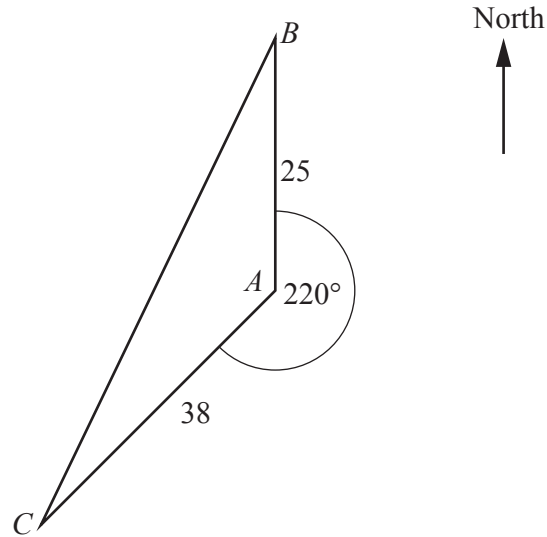


[3]

- (c) Find an estimate for the percentage of Sunil's calls that were longer than 25 minutes.

Answer % [2]

3



The diagram shows the positions of three towns, A , B and C .
 B is due north of A and the bearing of C from A is 220° .
 $AB = 25$ km and $AC = 38$ km.

- (a) Find the bearing of A from C .

Answer [1]

- (b) Show that $BC = 59.4$ km correct to 3 significant figures.

[3]

- (c) Calculate the bearing of C from B .

Answer [4]

4 Adam has a bag containing 9 balls, numbered from 1 to 9.

- (a) Adam takes a ball at random from the bag and replaces it.

Find the probability that the ball has an odd number.

Answer [1]

- (b) Adam takes a ball from the 9 balls in the bag, notes the number and replaces it.
He then takes a second ball from the bag, notes the number and replaces it.

- (i) Work out the probability that both numbers are odd.

Answer [1]

- (ii) Work out the probability that one number is odd and the other is even.

Answer [2]

- (c) Adam now takes two balls from the 9 balls in the bag, **without replacement**.

Work out the probability that the two numbers are either both odd or both even.

Answer [3]

5 (a) Solve $\frac{y}{2y+3} = \frac{2}{y+5}$.

Answer $y = \dots\dots\dots$ or $\dots\dots\dots$ [3]

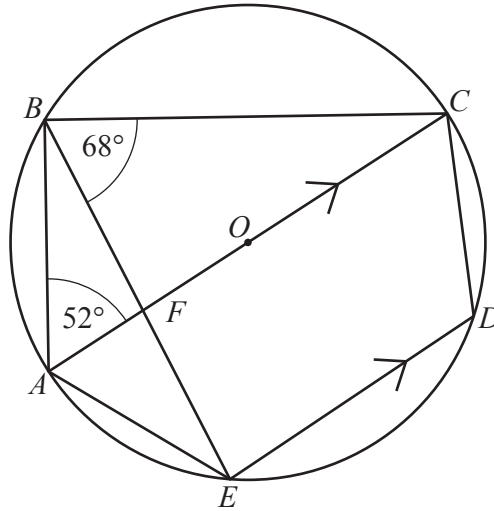
(b) Make t the subject of the formula $p = \frac{4t+1}{2-t}$.

Answer $\dots\dots\dots$ [3]

(c) Simplify fully $\frac{3x^2 - 14x + 8}{x^2 - 16}$.

Answer $\dots\dots\dots$ [3]

6 (a)



A, B, C, D and E are points on the circumference of the circle, centre O .

AC is a diameter and AC is parallel to ED .

AC and BE intersect at F .

$\hat{BAC} = 52^\circ$ and $\hat{CBE} = 68^\circ$.

(i) Find $\hat{ACB}$.

Answer $\hat{ACB} = \dots\dots\dots [1]$

(ii) Find $\hat{AEF}$.
Give a reason for your answer.

Answer $\hat{AEF} = \dots\dots\dots$ because $\dots\dots\dots [1]$

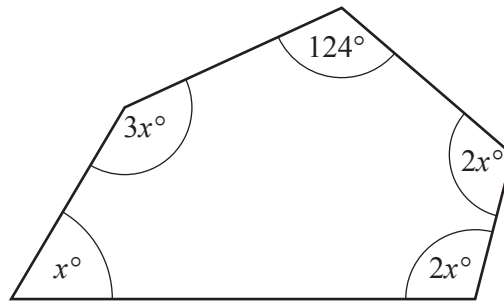
(iii) Find $\hat{CDE}$.

Answer $\hat{CDE} = \dots\dots\dots [1]$

(iv) Find $\hat{BCD}$.

Answer $\hat{BCD} = \dots\dots\dots [2]$

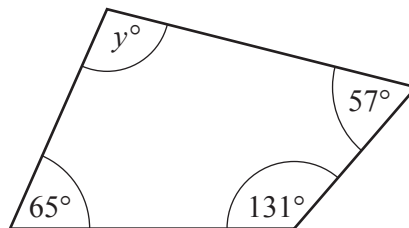
(b)



Work out the size of the largest angle in the pentagon.

Answer [3]

(c)



The angles in the quadrilateral are given correct to the nearest degree.

Find the lower bound for the value of y .

Answer [2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

- 7 (a) (i) The points $(4, -3)$ and $(0, 5)$ lie on the line L .

Find the equation of line L .

Answer [2]

- (ii) The line M is parallel to line L and passes through the point $(-2, 3)$.

Find the equation of line M .

Answer [2]

- (b) The table below shows some values of x and the corresponding values of y for $y = x + \frac{3}{x} - 3$.

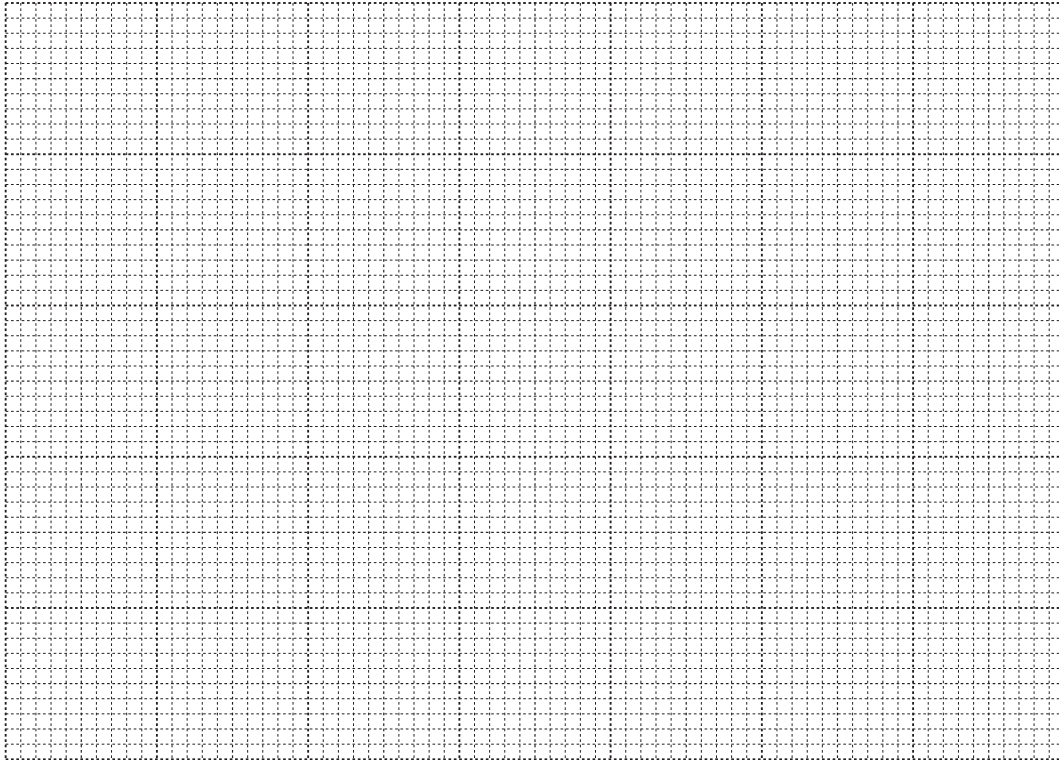
x	0.5	1	1.5	2	3	4	5	6
y	3.5	1	0.5	0.5	1	1.75	2.6	

- (i) Complete the table.

[1]

- (ii) Using a scale of 2 cm to 1 unit on both axes, draw a horizontal x -axis for $0 \leq x \leq 7$ and a vertical y -axis for $0 \leq y \leq 4$.

Draw the graph of $y = x + \frac{3}{x} - 3$ for $0.5 \leq x \leq 6$.



[3]

- (iii) By drawing a tangent, estimate the gradient of the curve at (1, 1).

Answer [2]

- (iv) Use your graph to solve the equation $x + \frac{3}{x} = 5$.

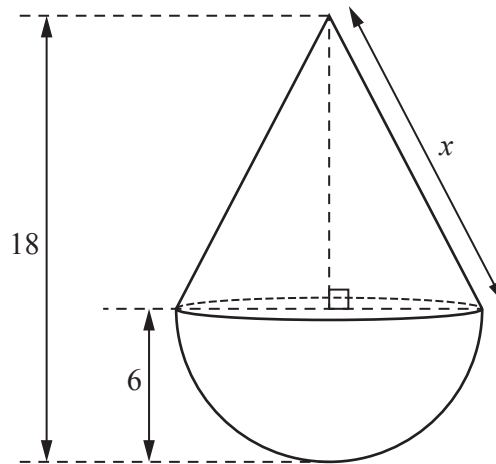
Answer $x =$ or [2]

8 [Volume of a cone = $\frac{1}{3}\pi r^2 h$]

[Curved surface area of a cone = $\pi r l$]

[Volume of a sphere = $\frac{4}{3}\pi r^3$]

[Surface area of a sphere = $4\pi r^2$]



The diagram shows solid *A* which is made from a hemisphere joined to a cone of equal radius. The hemisphere and the cone each have radius 6 cm. The total height of the solid is 18 cm.

(a) Show that the slant height, *x* cm, of the cone is 13.4 cm, correct to 1 decimal place.

[2]

(b) Calculate the total surface area of solid *A*.

Answer cm² [3]

- (c) Calculate the volume of solid A .

Answer cm^3 [3]

- (d) Solid A is one of a set of three geometrically similar solids, A , B and C .
The ratio of the heights of solid A : solid B : solid C is 2 : 6 : 1.

- (i) Calculate the surface area of solid B correct to 3 significant figures.

Answer cm^2 [2]

- (ii) Calculate the volume of solid C correct to 3 significant figures.

Answer cm^3 [2]

- 9 (a) A pump takes 12 minutes to add 3000 litres of water to a pond.

How long will it take the same pump to add 1750 litres of water to a pond?

Answer minutes [2]

- (b) A tank holds 2500 litres of oil.

A small pump can add oil to the tank at a rate of x litres per minute.

A large pump can add oil to the tank at a rate of $(x + 20)$ litres per minute.

- (i) Write down an expression, in terms of x , for the number of minutes the small pump takes to fill the empty tank.

Answer [1]

- (ii) It takes 15 minutes longer to fill the empty tank using the small pump than it does with the large pump.

Form an equation in x and show that it simplifies to $3x^2 + 60x - 10\,000 = 0$.

[3]

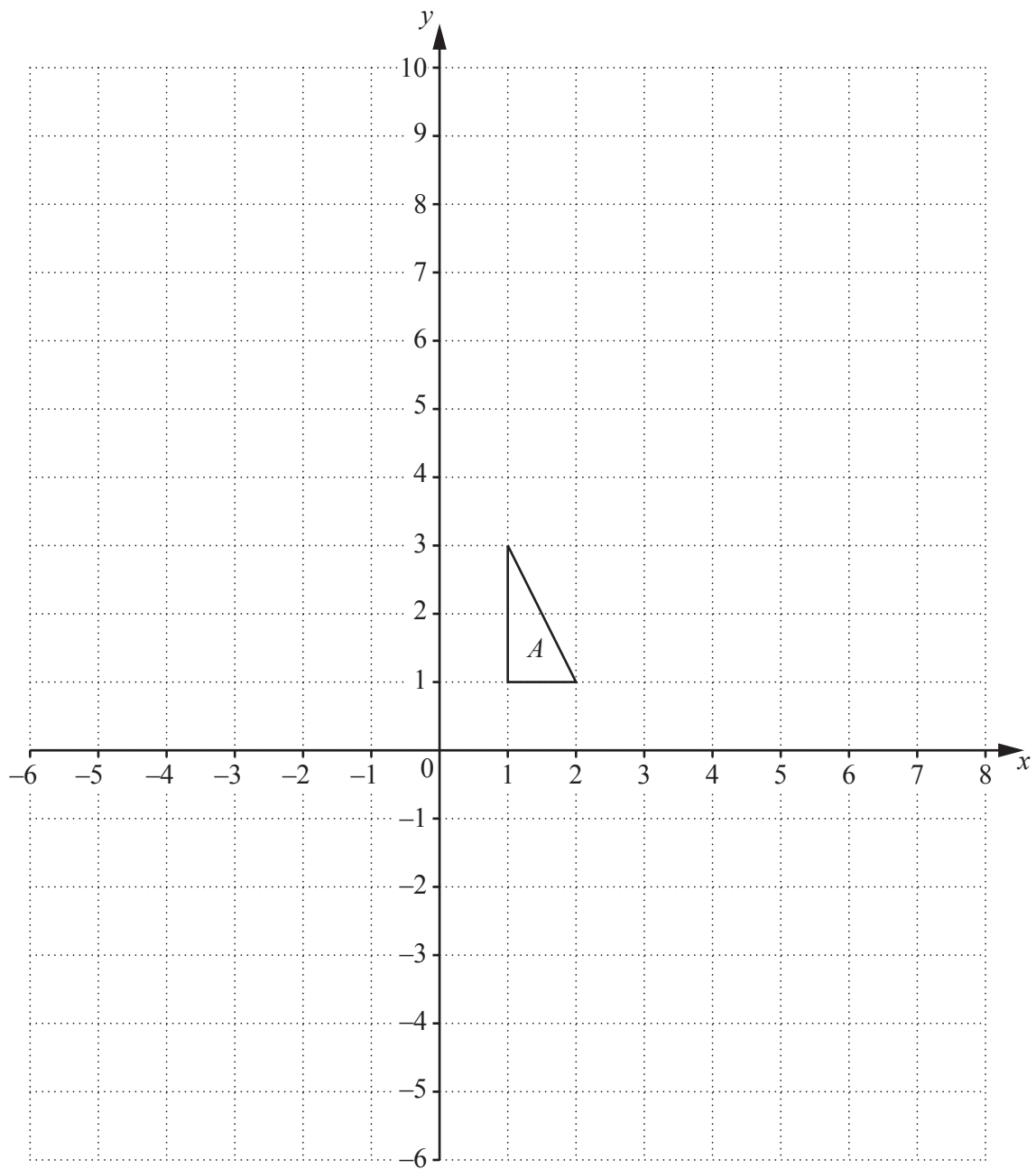
- (iii) Solve the equation $3x^2 + 60x - 10\,000 = 0$.
Give each answer correct to 2 decimal places.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (iv) Find the length of time the large pump takes to fill the empty tank.
Give your answer in minutes and seconds, correct to the nearest second.

Answer $\dots\dots\dots$ minutes $\dots\dots\dots$ seconds [3]

- 10 (a) Triangle A is shown on the grid.



- (i) Triangle A is mapped onto triangle B by a rotation of 180° about point $(2, -1)$.

Draw and label triangle B on the grid.

[2]

- (ii) Triangle A is mapped onto triangle C by the transformation represented by the matrix $\begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix}$.

Draw and label triangle C on the grid.

[2]

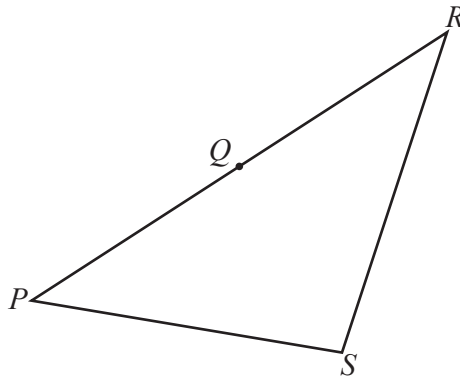
- (iii) Write down the matrix that represents the transformation that maps triangle C onto triangle A .

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [1]

- (iv) Describe fully the **single** transformation that maps triangle C onto triangle B .

.....
 [3]

- (b) The diagram shows triangle PRS .



Q is the midpoint of PR .

$$\overrightarrow{PQ} = \begin{pmatrix} 6 \\ 3 \end{pmatrix} \text{ and } \overrightarrow{PS} = \begin{pmatrix} 8 \\ -2 \end{pmatrix}.$$

- (i) Find $\overrightarrow{SR}$.

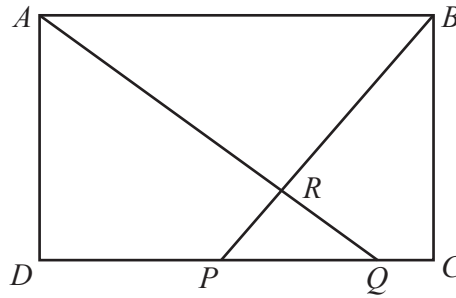
Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

- (ii) T is the point on SR such that $ST : TR = 1 : 3$.

Find $\overrightarrow{PT}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

11



$ABCD$ is a rectangle.
 P and Q are points on DC .
 AQ and BP intersect at R .

- (a) Prove that triangle ARB is similar to triangle QRP .
 Give a reason for each statement you make.

.....

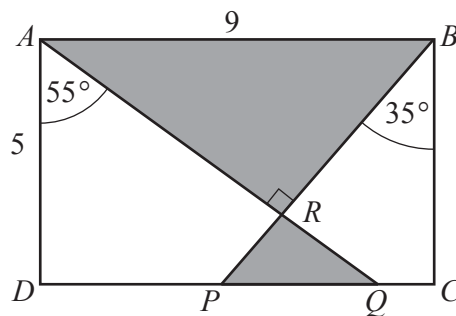
.....

.....

.....

..... [3]

(b)



In rectangle $ABCD$, $AB = 9$ cm and $AD = 5$ cm.
 $\hat{DAQ} = 55^\circ$, $\hat{CBP} = 35^\circ$ and AQ is perpendicular to BP .

- (i) Calculate AQ .

Answer cm [2]

(ii) Calculate AR .

Answer cm [2]

(iii) Calculate the area of triangle ARB .

Answer cm² [2]

(iv) Calculate the total area shaded in the rectangle.

Answer cm² [3]

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

October/November 2017

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **23** printed pages and **1** blank page.

Section A [52 marks]

Answer **all** questions in this section.

- 1 (a) Sara buys a new car.
The cash price of the car is \$4500.
She can pay for the car using option A or option B.

Option A	Option B
Pay $\frac{1}{5}$ of the cash price then 12 monthly payments of \$340	Pay 12% of the cash price then 24 monthly payments of \$195

Which option is cheaper and by how much?

Answer Option is cheaper by \$ [4]

- (b) Sara's car uses 5.2 litres of petrol for each 100 km she drives.
Petrol costs \$0.85 per litre.
Sara drives 240 km.

Calculate the cost of the petrol used for this journey.
Give your answer correct to the nearest cent.

Answer \$ [3]

- (c) Sara pays a total of \$322 for her car insurance.
This total is made up of a basic charge plus 15% sales tax.

Calculate the amount of sales tax that Sara pays.

Answer \$ [3]

- 2 A company asked their employees how long they took to travel to work one day. The table summarises the times for 120 employees.

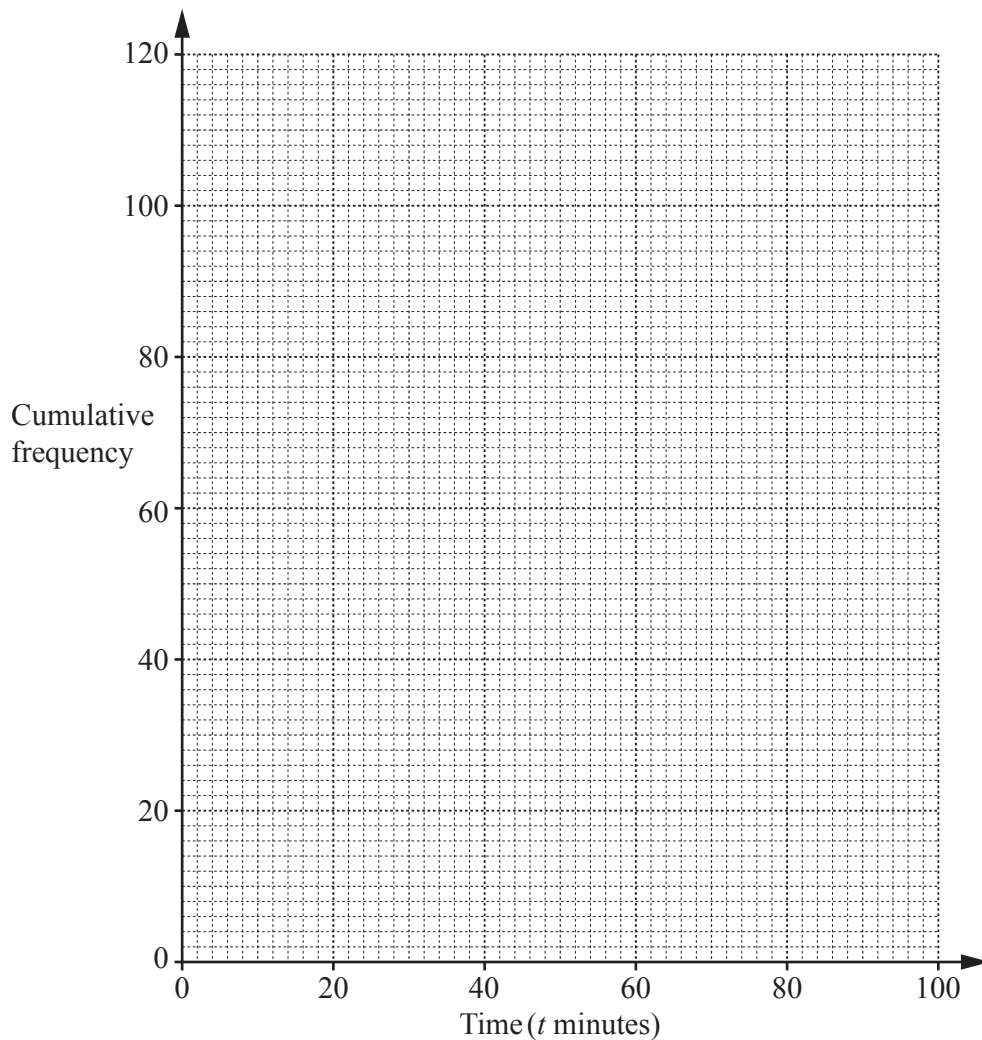
Time (t minutes)	$0 < t \leq 20$	$20 < t \leq 40$	$40 < t \leq 60$	$60 < t \leq 80$	$80 < t \leq 100$
Frequency	12	28	45	22	13

- (a) (i) Complete the cumulative frequency table below.

Time (t minutes)	$t \leq 0$	$t \leq 20$	$t \leq 40$	$t \leq 60$	$t \leq 80$	$t \leq 100$
Cumulative frequency	0					120

[1]

- (ii) On the grid, draw a smooth cumulative frequency curve to represent these results.



[2]

(b) Use your curve to estimate

(i) the median time,

Answer minutes [1]

(ii) the interquartile range of the times.

Answer minutes [2]

(c) Calculate an estimate of the mean time taken for the employees to travel to work.

Answer minutes [3]

3 Anya makes T-shirts.

The matrix, **M**, shows the number of T-shirts of different types she makes in one week.

$$\mathbf{M} = \begin{array}{ccc} \text{Small} & \text{Medium} & \text{Large} \\ \left(\begin{array}{ccc} 10 & 25 & 30 \\ 20 & 40 & 25 \end{array} \right) \begin{array}{l} \text{Men} \\ \text{Women} \end{array} \end{array}$$

- (a) Anya sells all of these T-shirts to a shop.
She charges \$5 for each small T-shirt, \$6 for each medium T-shirt and \$8 for each large T-shirt.

Represent these amounts in a 3×1 column matrix **N**.

Answer **N** = [1]

- (b) (i) Work out **P** = **MN**.

Answer **P** = [2]

- (ii) Explain what the elements in matrix **P** represent.

Answer
..... [1]

- (c) The shopkeeper sells all sizes of men's T-shirts at \$10 each.
He sells all sizes of women's T-shirts at \$9.50 each.
He sells all of these T-shirts.

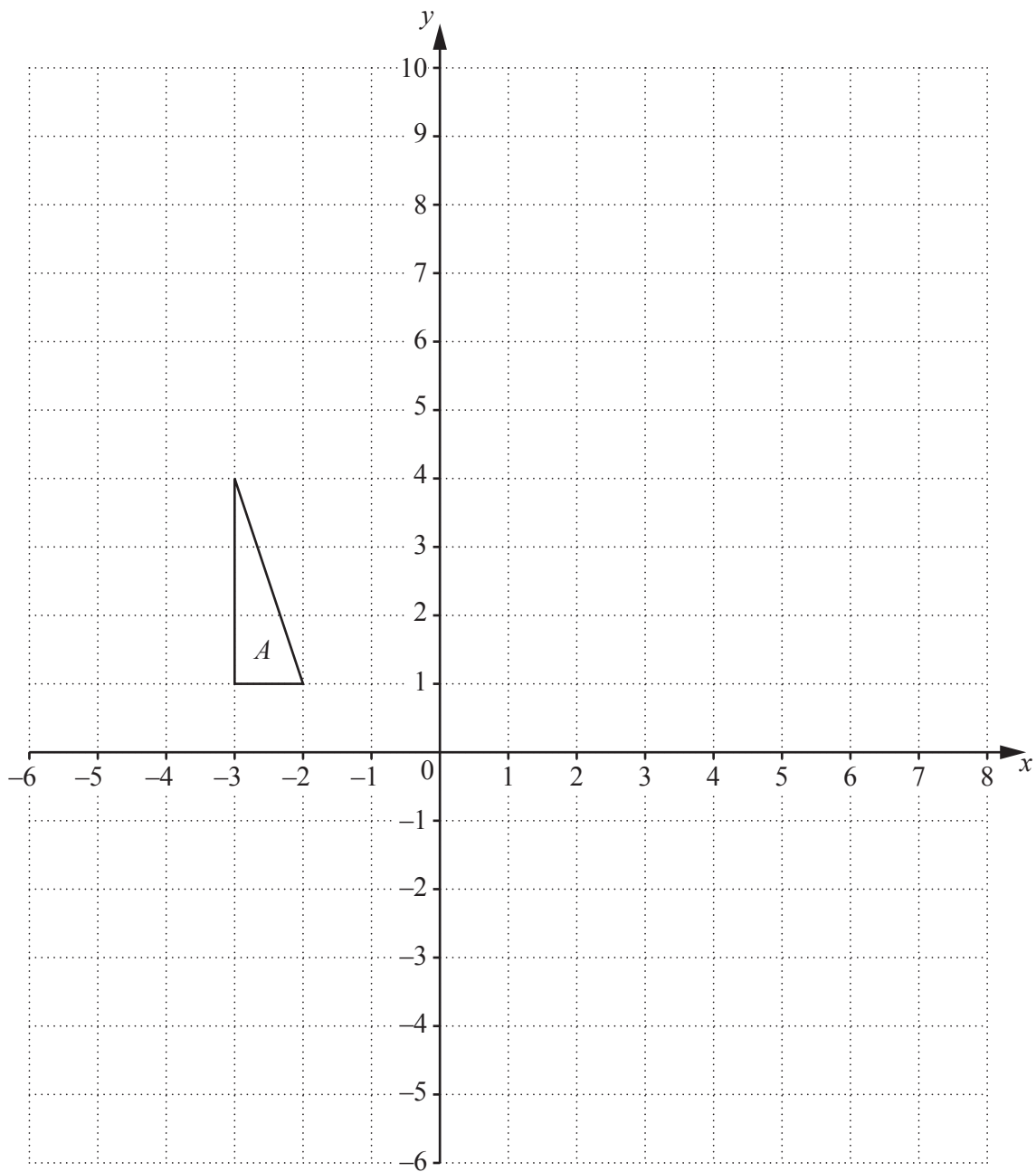
(i) Work out $(10 \quad 9.50) \begin{pmatrix} 10 & 25 & 30 \\ 20 & 40 & 25 \end{pmatrix}$.

Answer [2]

- (ii) Work out the percentage profit the shopkeeper makes when he sells all of the T-shirts.

Answer% [3]

- 4 (a) Triangle A is shown on the grid.



- (i) Triangle A is mapped onto triangle B by a translation of $\begin{pmatrix} 7 \\ -5 \end{pmatrix}$.

Draw and label triangle B on the grid.

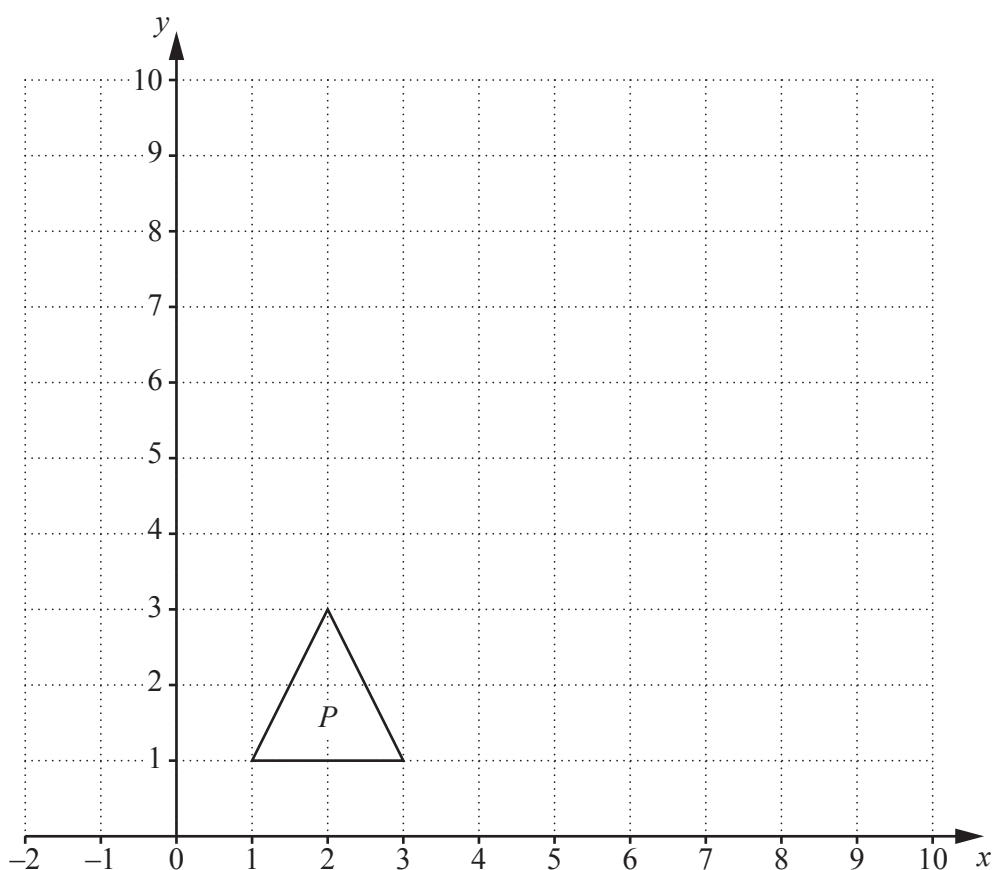
[2]

- (ii) Triangle A is mapped onto triangle C by an enlargement scale factor -2 , centre $(-1, 2)$.

Draw and label triangle C on the grid.

[2]

(b) Triangle P is shown on the grid.



The stretch S is represented by the matrix $\begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$.

Triangle P is mapped onto triangle Q by the stretch S .

(i) On the grid above, draw and label triangle Q .

[2]

(ii) Describe fully the stretch S .

.....

..... [2]

- 5 (a) Express as a single fraction in its simplest form $\frac{4}{x-2} - \frac{5}{x+1}$.

Answer [2]

- (b) Solve $2x(x+1) = 3(4-x)$.

Answer $x =$ or [3]

- (c) Anil and Yasmin buy some pens and notebooks from the same shop.

Anil buys 3 pens and 2 notebooks for \$4.80 .

Yasmin buys 5 pens and 4 notebooks for \$9.00 .

- (i) Form a pair of simultaneous equations to represent this information.

[1]

- (ii) Solve the simultaneous equations to find the cost of a pen and the cost of a notebook.

Answer Cost of pen = \$

Cost of notebook = \$[3]

6 (a) $\mathcal{E} = \{x : x \text{ is an integer and } 10 \leq x \leq 20\}$

$A = \{x : x \text{ is an odd number}\}$

$B = \{x : x \text{ is a multiple of } 5\}$

(i) Find $n(A \cap B)$.

Answer [1]

(ii) Find $A' \cup B$.

Answer [1]

(iii) A number, r , is chosen at random from $\mathcal{E}$.

Find the probability that $r \in A \cup B$.

Answer [1]

(b) In a survey, 40 people were asked what they had read that day.

- A total of 10 people had read a book
- A total of 24 people had read a newspaper
- 14 people had read neither a book nor a newspaper

(i) By drawing a Venn diagram, or otherwise, find the number of people who had read both a book and a newspaper.

Answer [2]

(ii) Two of the 10 people who had read a book are selected at random.

Work out the probability that they had both read a book and a newspaper.

Answer [2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

- 7 (a) The variables x and y are connected by the equation $y = 3 + x - \frac{x^2}{2}$.

Some corresponding values of x and y are given in the table below.

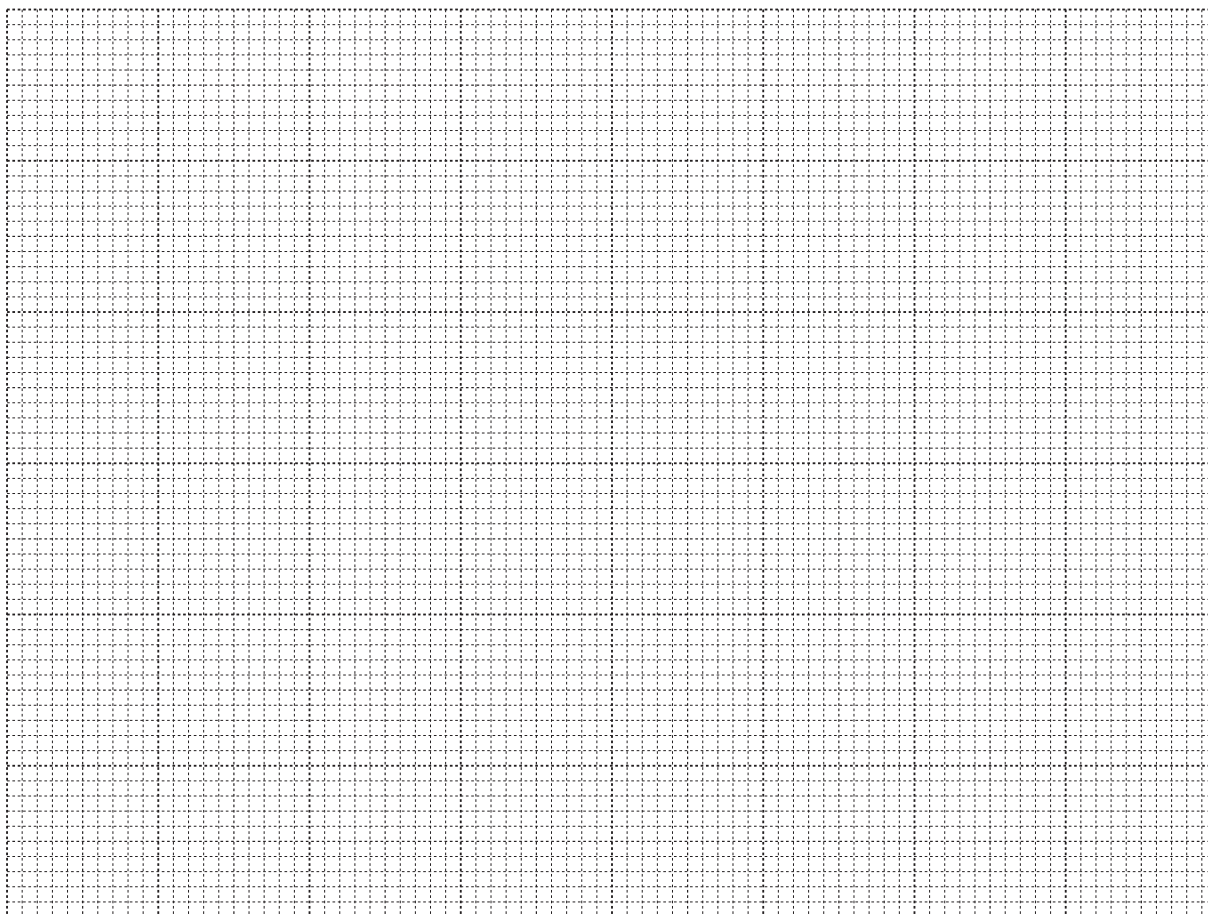
x	-3	-2	-1	0	1	2	3	4	5
y		-1	1.5	3	3.5	3	1.5	-1	

- (i) Complete the table.

[1]

- (ii) Using a scale of 2 cm to 1 unit, draw a horizontal x -axis for $-3 \leq x \leq 5$.
Using a scale of 1 cm to 1 unit, draw a vertical y -axis for $-5 \leq y \leq 5$.

Draw the graph of $y = 3 + x - \frac{x^2}{2}$ for $-3 \leq x \leq 5$.



[3]

- (iii) By drawing a tangent, estimate the gradient of the curve at (3, 1.5).

Answer [2]

- (iv) The points of intersection of the graph of $y = 3 + x - \frac{x^2}{2}$ and the line $y = k$ are the solutions of the equation $10 + 2x - x^2 = 0$.

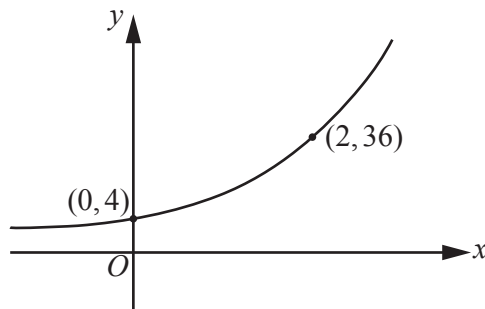
(a) Find the value of k .

Answer [1]

- (b) By drawing the line $y = k$ on your graph, find the solutions of the equation $10 + 2x - x^2 = 0$.

Answer [2]

- (b) This is a sketch of the graph of $y = pa^x$, where $a > 0$. The graph passes through the points $(0, 4)$ and $(2, 36)$.



- (i) Write down the value of p .

Answer [1]

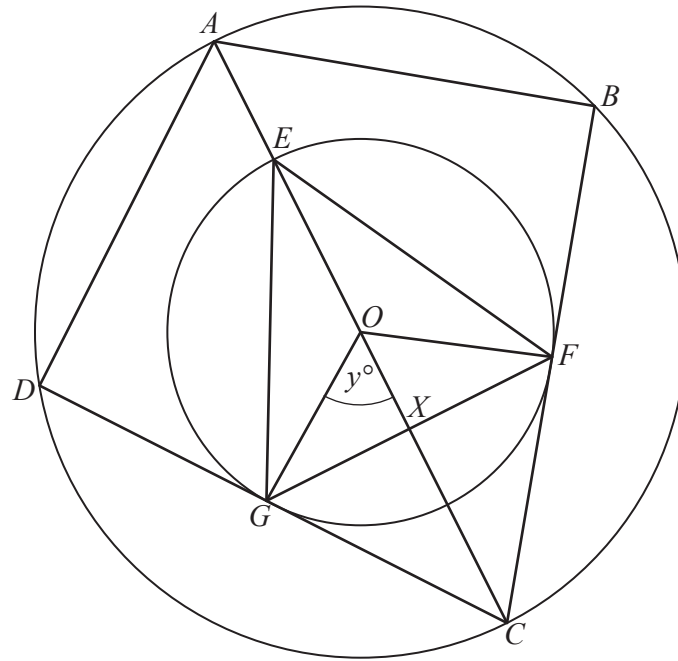
- (ii) Find the value of a .

Answer [1]

- (iii) The graph passes through the point $(4, q)$.

Find the value of q .

Answer [1]



The diagram shows two circles each with centre O .
 A, B, C and D are points on the circumference of the large circle.
 E, F and G are points on the circumference of the small circle.
 CGD and CFB are tangents to the small circle.
 Lines AE and OC intersect at 90° at X .
 $\hat{GOX} = y^\circ$.

- (a) Find each of these angles, as simply as possible, in terms of y .
 Give reasons for your answers.

(i) $\hat{GEO}$

Answer $\hat{GEO} = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]

(ii) $\hat{GCX}$

Answer $\hat{GCX} = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]

(iii) $\hat{DAB}$

Answer $\hat{DAB} = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]

- (b) Complete the sentence.

Triangle EGC is congruent to triangle [1]

- (c) Prove that triangle ADC is similar to triangle OGC .
Give a reason for each statement you make.

.....

 [2]

- (d) What special type of quadrilateral is $AOGD$?

Answer [1]

- (e) Find the ratio

- (i) area of triangle OGC : area of triangle ADC ,

Answer : [1]

- (ii) area of triangle OGC : area of quadrilateral $ABCD$.

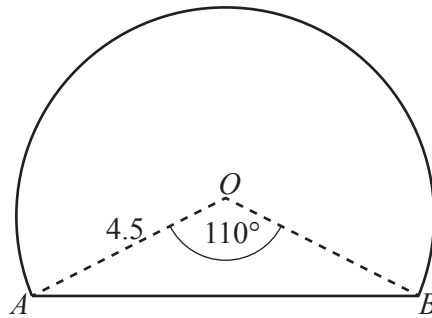
Answer : [1]

- 9 (a) The ventilation shaft for a tunnel is in the shape of a cylinder. The cylinder has radius 0.4 m and length 15 m.

Calculate the volume of the cylinder.

Answer m^3 [2]

- (b) The diagram shows the cross-section of the tunnel.



The cross-section of the tunnel is a major segment of a circle, centre O . The radius of the circle is 4.5 m and $\angle AOB = 110^\circ$.

Calculate the area of the cross-section of the tunnel.

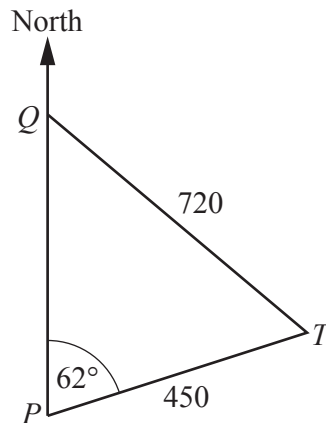
Answer m^2 [4]

- (c) The length of the tunnel is 1750 m.
A car drives through the tunnel at an average speed of 45 km/h.

Work out the time the car takes to travel through the tunnel.
Give your answer in minutes and seconds.

Answer minutes seconds [2]

- (d) The diagram shows the position of the tunnel entrance, T , and two road junctions, P and Q , on horizontal ground.

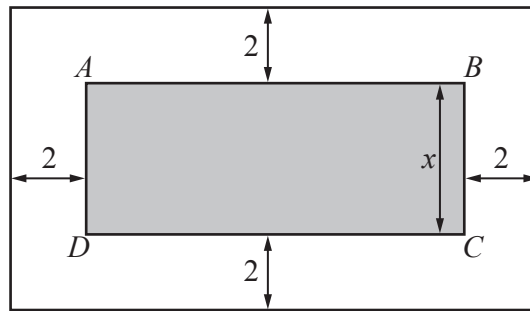


Q is due north of P and T is on a bearing of 062° from P .
 $PT = 450$ m and $QT = 720$ m.

Calculate the bearing of T from Q .

Answer [4]

- 10 A rectangular picture, $ABCD$, is placed inside a rectangular frame.



The length, AB , of the picture is three times its height, x cm.
The width of the frame is 2 cm.

- (a) The total area of the picture and the frame is 476 cm^2 .

Form an equation in x and show that it simplifies to $3x^2 + 16x - 460 = 0$.

[4]

- (b) Solve the equation $3x^2 + 16x - 460 = 0$.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (c) Find the height and length of the **frame**.

Answer Height = cm

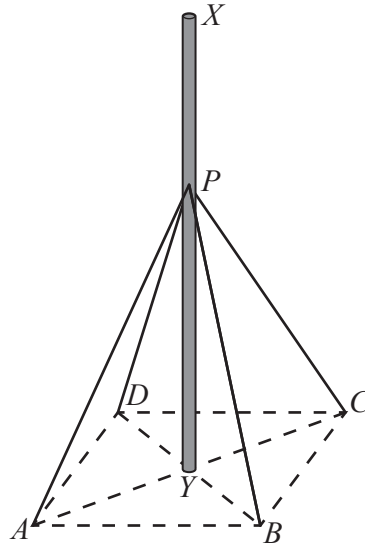
Length = cm [2]

- (d) The frame is made from wood.
The wood is 5 mm thick.
The mass of 1 cm³ of the wood is 0.7 g.

Calculate the mass of wood used in the frame.

Answer g [3]

11



A vertical mast, XY , is positioned on horizontal ground.

The mast is supported by four cables attached to the mast at P and to the ground at points A , B , C and D .

Y is the centre of the square $ABCD$.

$PY = 7.50$ m.

(a) Given that $AB = 3.65$ m, show that $AY = 2.58$ m correct to 3 significant figures.

[3]

(b) Calculate the length of one of the cables used to support the mast.

Answer m [2]

- (c) Calculate $\hat{APB}$.

Answer [3]

- (d) The angle of elevation of X from A is 77.0° .

- (i) Calculate the height, XY of the mast.

Answer m [2]

- (ii) Calculate the angle of elevation of X from the midpoint of AB .

Answer [2]

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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

October/November 2018

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

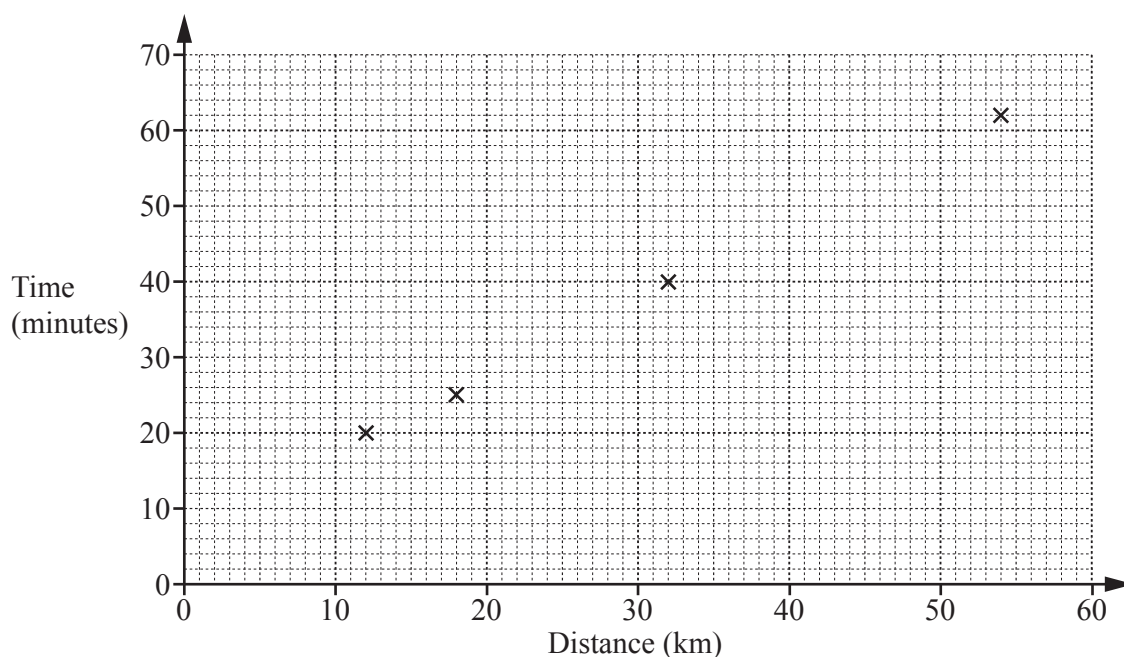
The total of the marks for this paper is 100.

This document consists of **20** printed pages.

- 1 (a) The table shows the distances 10 people drive to work and the times they take.

Distance (km)	12	32	18	54	26	36	29	15	20	42
Time (minutes)	20	40	25	62	35	34	32	18	32	50

- (i) On the grid, complete the scatter diagram to show this information. The first four points have been plotted for you.



[2]

- (ii) What type of correlation does the scatter diagram show?

Answer [1]

- (iii) One of these 10 people is selected at random.

Find the probability that this person drove less than 30 km to work.
Give your answer as a fraction in its simplest form.

Answer [2]

- (iv) Ateeq drives 48 km to work.

By drawing a line of best fit on the scatter diagram, estimate the time Ateeq takes to travel to work.

Answer minutes [2]

(b) The table summarises the times taken by the 120 employees in a company to travel to work.

Time (t minutes)	$0 < t \leq 20$	$20 < t \leq 40$	$40 < t \leq 60$	$60 < t \leq 80$	$80 < t \leq 100$
Frequency	29	38	26	21	6

(i) Write down the modal class.

Answer [1]

(ii) Calculate an estimate of the mean time.

Answer minutes [3]

(iii) Work out the percentage of employees who took more than 1 hour to travel to work.

Answer % [2]

2 Dina owns a clothes shop.

(a) Maryam works in the shop.

She works for 5 days each week from 10 am until 6.30 pm.

She has a break of 45 minutes each day.

She is paid \$10.20 for each hour she works but she is not paid for her breaks.

Work out how much Maryam earns for one week's work.

Answer \$ [3]

(b) Dina buys 25 dresses from a manufacturer.

She pays a total of \$400 for these dresses.

She sells all the dresses for \$19.80 each.

Calculate her percentage profit.

Answer % [2]

(c) Dina sells a shirt for \$15.66 .

The price includes 8% sales tax.

Calculate the cost of the shirt excluding sales tax.

Answer \$ [2]

(d) Dina is saving to make improvements to her shop.

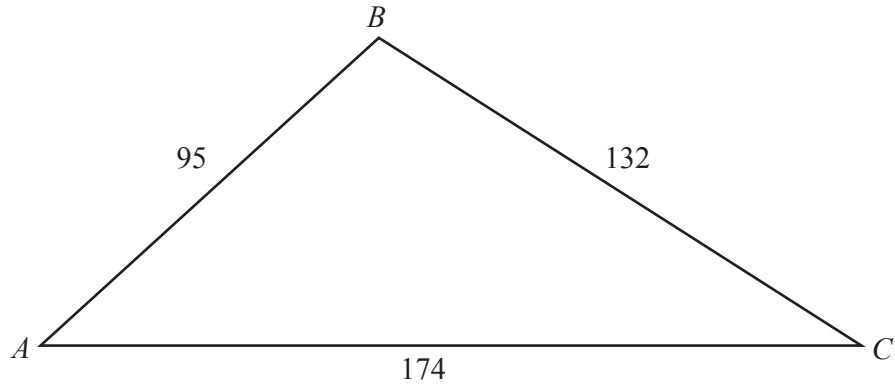
She invests \$3500 for 4 years at 1.7% per year compound interest.

Calculate the value of Dina's investment after 4 years.

Give your answer correct to the nearest cent.

Answer \$ [3]

3



The diagram shows a triangular field ABC .
 $AB = 95$ m, $BC = 132$ m and $AC = 174$ m.

- (a) Show that $\hat{BAC} = 48.6^\circ$, correct to 1 decimal place.

[3]

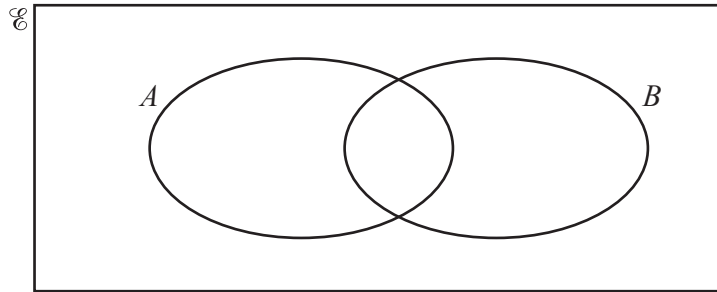
- (b) The field is sown with flower seeds.
 Each square metre of the field is sown with 3 grams of seed.
 The seed costs \$8.50 for 100 grams.

Calculate the cost of the flower seed needed for the field.

Answer \$ [4]

- 4 (a) $\mathcal{C} = \{x : x \text{ is an integer } 1 \leq x \leq 10\}$
 $A = \{x : x \text{ is a factor of } 20\}$
 $B = \{x : x \text{ is a multiple of } 4\}$

(i) Complete the Venn diagram.



[2]

(ii) State $n(A \cup B)$.

Answer [1]

(iii) Describe in words the set $A \cap B'$.

Answer [1]

- (b) 30 people are asked what type of fruit they like.
Of these people,

- 5 say they like both oranges and bananas
- 12 say they like oranges
- 8 say they like neither oranges nor bananas.

- (i) By drawing a Venn diagram, or otherwise, find the number of people who like bananas but not oranges.

Answer [2]

- (ii) Two of the 30 people are selected at random.

Find the probability that they both like oranges but not bananas.

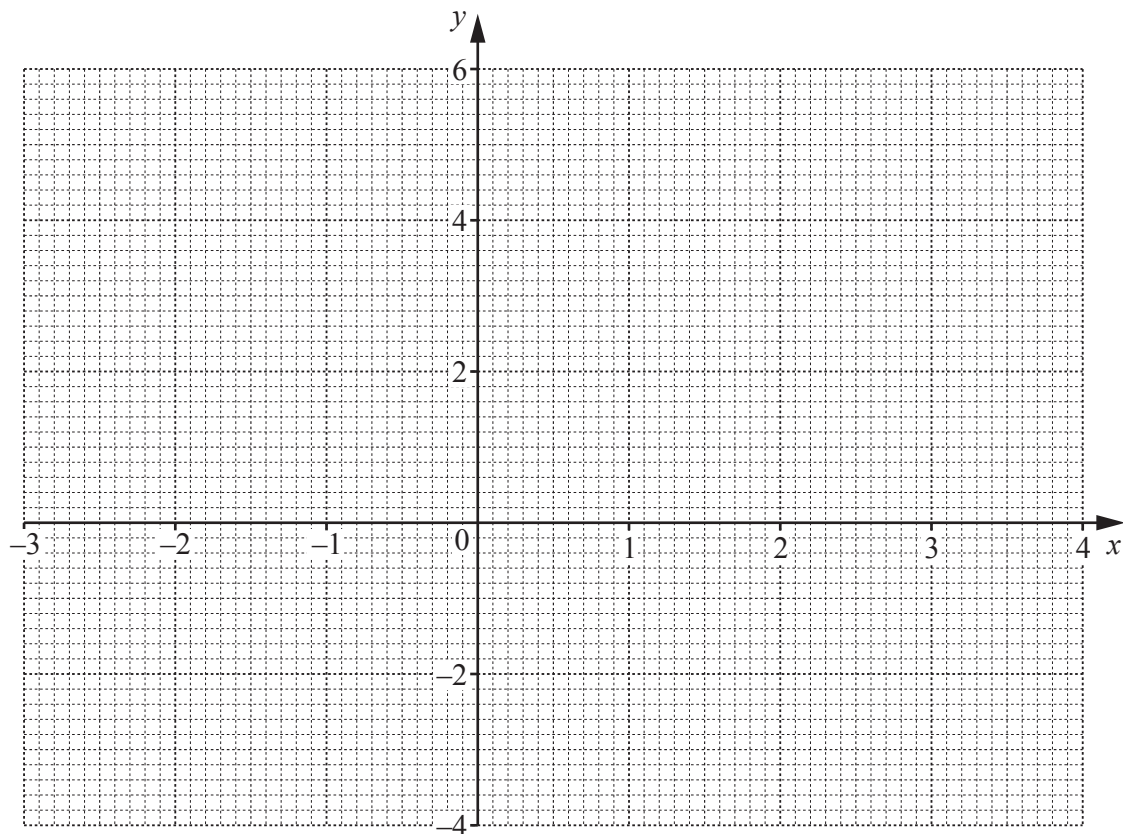
Answer [2]

- 5 (a) Complete the table for $y = \frac{x}{5}(6 + 2x - x^2)$.

x	-3	-2	-1	0	1	2	3	4
y	5.4	0.8	-0.6	0	1.4	2.4	1.8	

[1]

- (b) Draw the graph of $y = \frac{x}{5}(6 + 2x - x^2)$ for $-3 \leq x \leq 4$.



[3]

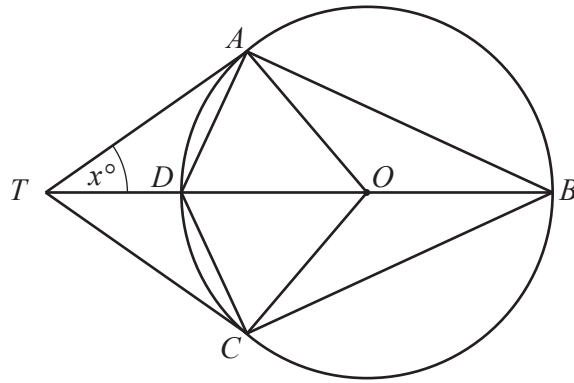
- (c) By drawing a tangent, estimate the gradient of $y = \frac{x}{5}(6 + 2x - x^2)$ at $(-2, 0.8)$.

Answer [2]

- (d) Use your graph to solve the equation $x(6 + 2x - x^2) = 10$.

Answer [3]

6



A, B, C and D are points on the circle centre O .
 TA and TC are tangents to the circle.
 $TDOB$ is a straight line.
 $\hat{ATO} = x^\circ$.

- (a) Show that triangle OAT is congruent to triangle OCT .
 Give a reason for each statement you make.

.....

 [3]

- (b) Find, in terms of x , giving your answers as simply as possible

(i) $\hat{ATO}$,

Answer $\hat{ATO} = \dots\dots\dots$ [1]

(ii) $\hat{OAB}$,

Answer $\hat{OAB} = \dots\dots\dots$ [1]

(iii) reflex $\hat{ADC}$.

Answer reflex $\hat{ADC}$ = [1]

(c) The radius of the circle is 6 cm.

Given that $x = 35^\circ$, work out BT .

Answer cm [3]

7 The position vector, $\overrightarrow{OA}$, of point A is $\begin{pmatrix} -4 \\ 7 \end{pmatrix}$ and $\overrightarrow{AB} = \begin{pmatrix} 6 \\ -3 \end{pmatrix}$.

(a) Find the position vector, $\overrightarrow{OB}$, of point B .

Answer $\overrightarrow{OB} = \begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [1]

(b) Find $|\overrightarrow{AB}|$.

Answer [2]

(c) Given that $\overrightarrow{AB} = 3\overrightarrow{CB}$, find the coordinates of point C .

Answer (.....,) [2]

(d) Line L is parallel to $\overrightarrow{AB}$ and passes through the point $(-2, 5)$.

(i) Find the equation of line L .

Answer [3]

(ii) Line M is perpendicular to line L and passes through the origin.

Find the equation of line M .

Answer [1]

- 8 The diagram shows part of a number grid.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

A vertical rectangle enclosing three numbers, as shown, can be placed anywhere on the grid.

The grid is continued downwards.

- (a) If n represents the number in the top of the rectangle, complete the rectangle with expressions, in terms of n , for the other two numbers.

n

[1]

- (b) Omar multiplies the top number in the rectangle by the bottom number.
He then squares the middle number in the rectangle.
He finds the difference between these two results.

Using your answers to part (a), show that this difference is always 25.

[2]

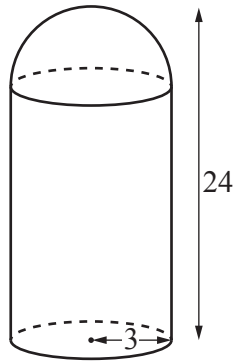
- (c) Lena places a rectangle on the grid.
She adds the three numbers in her rectangle.
The sum of the three numbers is 174.

Find the **largest** number in Lena's rectangle.

Answer [3]

9 (a) [Volume of a sphere = $\frac{4}{3}\pi r^3$]

[Surface area of a sphere = $4\pi r^2$]



The diagram shows lamp *A*.

It is made in the shape of a cylinder with a hemisphere on top.

The radius of the hemisphere and the radius of the cylinder are both 3 cm.

The total height of the lamp is 24 cm.

- (i) Show that the volume of lamp *A* is 650 cm^3 , correct to 3 significant figures.

[4]

- (ii) Calculate the curved surface area of lamp *A*.

Answer cm^2 [3]

- (iii) Lamp B is mathematically similar to lamp A .
The volume of lamp B is 450 cm^3 .

Calculate the total height of lamp B .

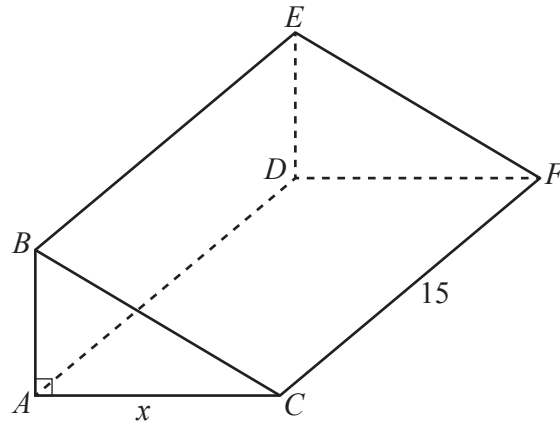
Answer cm [2]

- (b) The mass of lamp C is 340 g, correct to the nearest 10 g.
8 of these lamps are placed in a packing case.
The total mass of the packing case and the 8 lamps is 4.2 kg, correct to the nearest 0.1 kg.

Calculate the upper bound of the mass of the packing case when empty.
Give your answer in kilograms.

Answer kg [3]

10



The diagram shows a prism with a rectangular base of length 15 cm and width x cm.
 The cross section of the prism is a right-angled triangle.
 The height of the prism is 4 cm less than its width.
 The volume of the prism is 440 cm^3 .

- (a) Show that $3x^2 - 12x - 176 = 0$.

[3]

- (b) Solve the equation $3x^2 - 12x - 176 = 0$.
 Show your working and give your answers correct to 2 decimal places.

Answer $x = \dots\dots\dots$ or $x = \dots\dots\dots$ [3]

- (c) Find the height of the prism.

Answer $\dots\dots\dots$ cm [1]

- (d) A line is drawn on the surface of the prism from B to F .
Another line is drawn on the surface of the prism from A to F .
Calculate angle AFB .

Answer Angle $AFB =$ [4]

Question 11 is printed on the next page

- 11 (a) Express as a single fraction in its simplest form $\frac{4}{2x-3} - \frac{3}{x-2}$.

Answer [3]

- (b) Simplify $\frac{4x^2-9}{2x^2-7x-15}$.

Answer [3]

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

October/November 2018

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **19** printed pages and **1** blank page.

- 1 (a) Kamal earned a total of \$32 500 in 2017.
He paid 9% of this amount into his pension.
He paid 22% tax on the remainder of his earnings.

Calculate the amount left after paying his pension and his tax.

Answer \$ [3]

- (b) Kamal invested \$1200 in a savings account paying 1.8% per year compound interest.
He left the money in the account for 5 years.

Calculate the amount of money in the account at the end of 5 years.
Give your answer correct to the nearest cent.

Answer \$ [3]

- (c) Kamal also invested some money in a different savings account for 5 years.
This account paid 2.1% per year **simple** interest.
At the end of 5 years there was \$828.75 in the account.

Calculate the amount of money he invested in this account.

Answer \$ [3]

- (d) The exchange rate between dollars (\$) and pounds (£) is $\$1 = \pounds 0.72$.
The exchange rate between dollars and euros (€) is $\$1 = \text{€}1.10$.

Kamal has \$275.

He changes part of the \$275 into pounds and receives £79.20.

He changes the remaining dollars into euros.

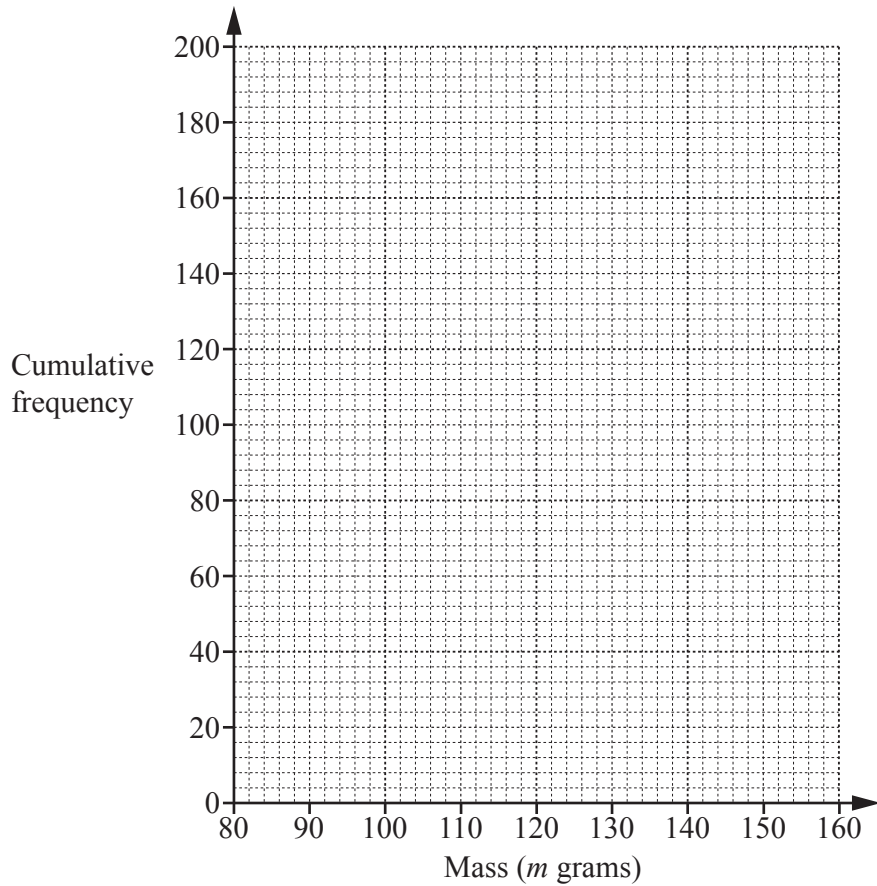
Calculate the amount of money he receives in euros.

Answer € [3]

- 2 Lim grows tomatoes.
The masses, m grams, of 200 of her tomatoes are recorded.
The cumulative frequency table shows the results.

Mass (m grams)	$m \leq 80$	$m \leq 100$	$m \leq 110$	$m \leq 120$	$m \leq 130$	$m \leq 140$	$m \leq 160$
Cumulative frequency	0	20	48	112	158	184	200

- (a) On the grid, draw a cumulative frequency diagram to represent these results.



[2]

- (b) Use your diagram to estimate

- (i) the median,

Answer g [1]

- (ii) the interquartile range.

Answer g [2]

- (c) Ravi also grows tomatoes.

The masses of 200 of his tomatoes are also recorded.

For Ravi's tomatoes, the median mass was 124g and the interquartile range of the masses was 12g.

Make two comments comparing the masses of tomatoes grown by Lim with those grown by Ravi.

1

.....

2

..... [2]

- (d) (i) Complete the frequency table for the masses of tomatoes grown by Lim.

Mass (m grams)	Frequency
$80 < m \leq 100$	20
$100 < m \leq 110$	28
$110 < m \leq 120$	64
$120 < m \leq 130$	
$130 < m \leq 140$	
$140 < m \leq 160$	16

[1]

- (ii) Write down the modal class.

Answer [1]

- (iii) Calculate an estimate for the mean mass of these tomatoes.

Answer g [3]

- 3 (a) Express as a single fraction in its simplest form $\frac{3}{y-1} - \frac{5}{y+6}$.

Answer [3]

- (b) Simplify $\frac{2v^2 - 5v - 12}{v^2 - 16}$.

Answer [3]

- (c) Solve $3(x^2 + 3) = 11x$.
Show your working and give your answers correct to 3 significant figures.

Answer $x = \dots\dots\dots$ or $x = \dots\dots\dots$ [4]

- 4 (a) Anna drives 45 km to work each day.
One day she drives the first 25 km at an average speed of 82 km/h.
She takes 36 minutes to drive the remaining distance.

Calculate her average speed, in km/h, for the whole journey.

Answer km/h [3]

- (b) Anna's journey home is 47 km, correct to the nearest kilometre.
One day her journey home takes 65 minutes, correct to the nearest 5 minutes.

Calculate the upper bound of her average speed, in km/h, for the journey home.

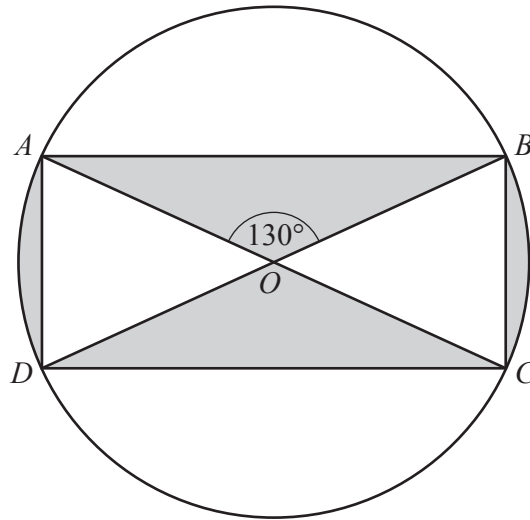
Answer km/h [3]

- (c) The probability that Anna arrives at work on time or early on any given day is $\frac{5}{8}$.

Calculate the probability that she is **late** on both Monday and Tuesday.
Give your answer as a fraction.

Answer [2]

5



AC and BD are diameters of the circle, centre O .
 $AC = 12$ cm and $\angle AOB = 130^\circ$.

(a) Calculate the area of triangle AOB .

Answer cm^2 [2]

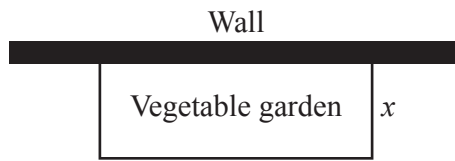
(b) Calculate the area of the sector AOD .

Answer cm^2 [2]

- (c) Calculate the percentage of the area of the circle that is shaded.

Answer % [4]

- 6 Zara fences off a piece of land next to a wall to make a vegetable garden.



The garden is a rectangle with the wall as one side of the rectangle.
 The area of the garden is 18 square metres.
 The width of the garden is x metres.

- (a) The total length of fencing required for the garden is y metres.

Show that $y = 2x + \frac{18}{x}$.

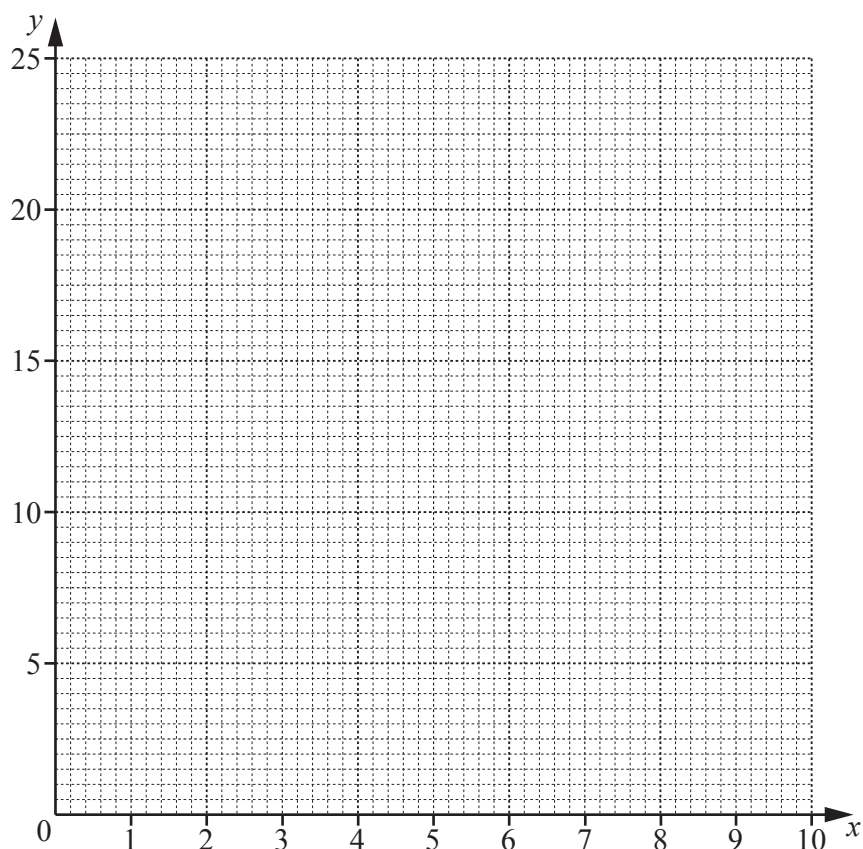
[1]

- (b) (i) Complete the table for $y = 2x + \frac{18}{x}$.

x	1	2	3	4	5	6	7	8	9
y			12	12.5	13.6	15	16.6	18.3	

[2]

- (ii) On the grid, draw the graph of $y = 2x + \frac{18}{x}$ for $1 \leq x \leq 9$.



[3]

- (c) Use your graph to find the two possible widths of the garden if 14 metres of fencing is used.

Answer m or m [2]

- (d) The fencing costs \$20 per metre.

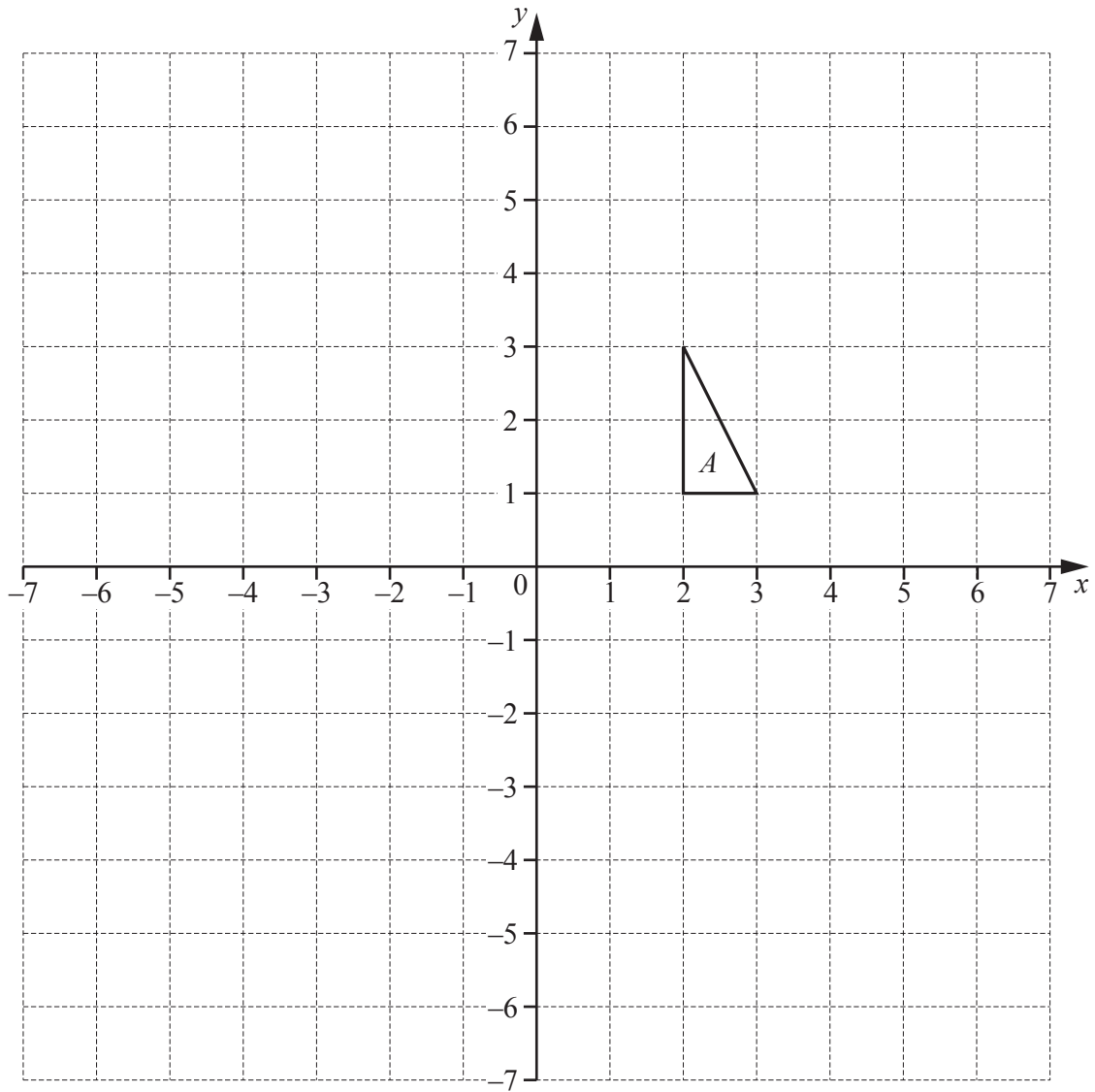
- (i) Find the minimum amount it will cost Zara to build the fence.

Answer \$ [2]

- (ii) Zara wants to spend no more than \$350 on the fence.

Find the greatest possible width of the garden Zara can make.

Answer m [2]



Triangle A is drawn on the grid.

- (a) Transformation P is represented by the matrix $\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$.

P maps triangle A onto triangle B .

- (i) Draw and label triangle B .

- (ii) Describe fully the single transformation P.

.....
 [2]

- (iii) Write down the ratio area of triangle A : area of triangle B .

Answer : [1]

- (b) Transformation Q is represented by the matrix $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$.

Q maps triangle B onto triangle C .

Draw and label triangle C . [2]

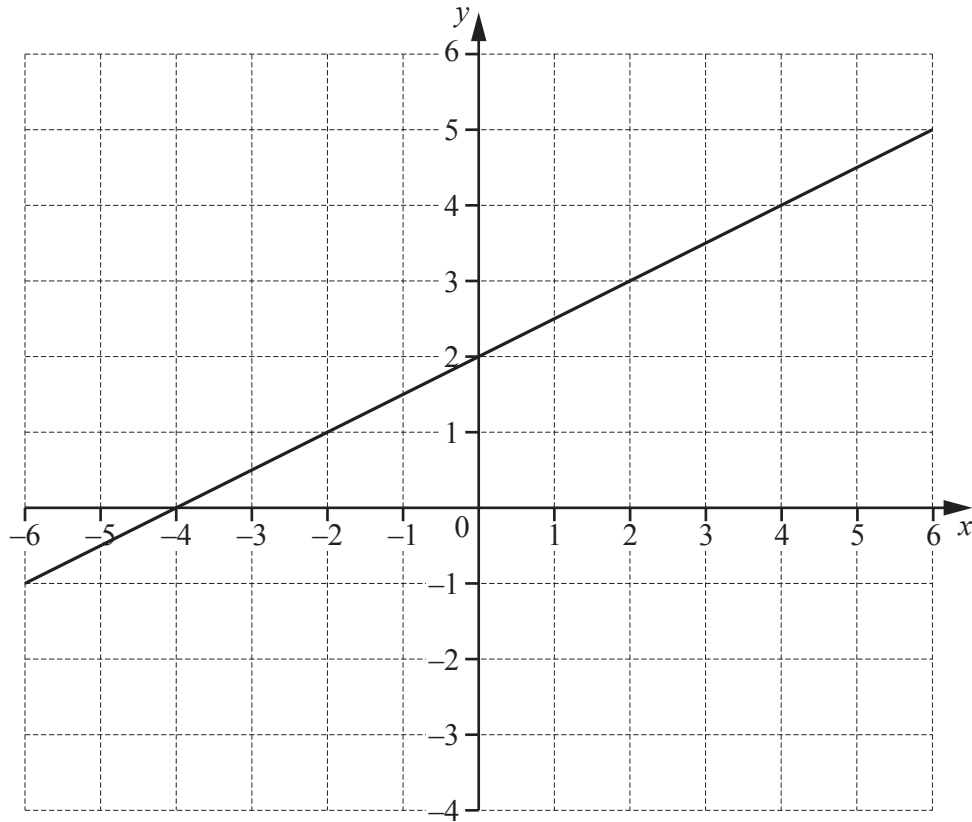
- (c) Transformation Y is represented by the matrix $\begin{pmatrix} 1 & 0 \\ 0 & 3 \end{pmatrix}$.

Y maps triangle A onto triangle D .

Find the matrix that represents the transformation that maps triangle D onto triangle A .

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

8



The line $2y = x + 4$ is drawn on the grid.

(a) (i) On the grid, draw the line $x + y + 2 = 0$.

[2]

(ii) The region R is represented by these three inequalities.

$$\begin{aligned} 2y &\geq x + 4 \\ x + y + 2 &\geq 0 \\ y &\leq 2 \end{aligned}$$

On the grid, shade and label the region R.

[2]

- (b) Line L is perpendicular to the line $2y = x + 4$.
Line L passes through the point $(1, 8)$.

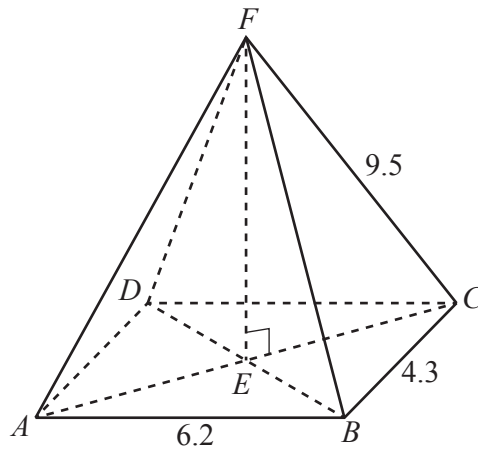
Show that the equation of line L is $y = 10 - 2x$.

[3]

- (c) Use an algebraic method to find the coordinates of the point of intersection of the lines $2y = x + 4$ and $y = 23 - 2x$.

Answer (..... ,) [3]

- 9 [Volume of a pyramid = $\frac{1}{3} \times \text{base area} \times \text{height}$]



The diagram shows a pyramid with a rectangular, horizontal base.
 Vertex F of the pyramid is vertically above the centre of the base, E .
 $AB = 6.2$ cm and $BC = 4.3$ cm.
 The length of each sloping edge of the pyramid is 9.5 cm.

- (a) Show that the height, EF , of the pyramid is 8.72 cm, correct to 3 significant figures.

[4]

- (b) Calculate the volume of the pyramid.

Answer cm³ [2]

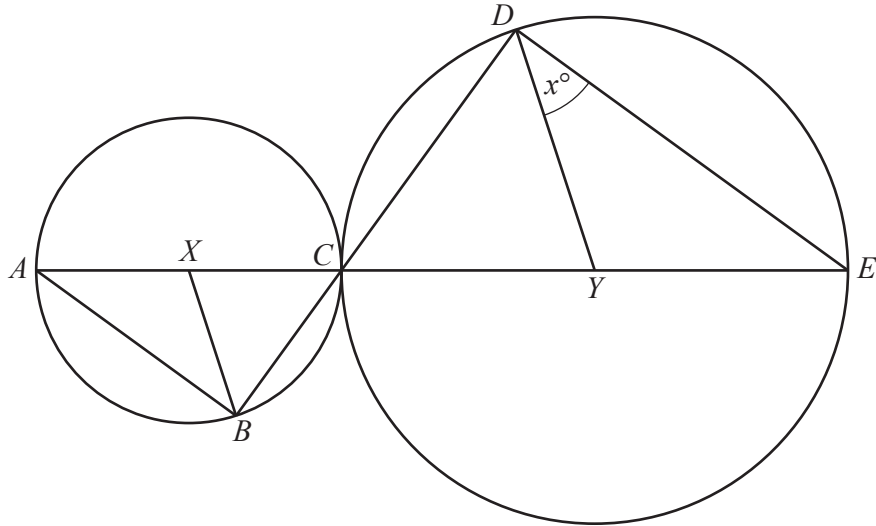
(c) Calculate angle AFB .

Answer [3]

(d) Calculate the angle of elevation of F from the midpoint of AB .

Answer [2]

10



The diagram shows two circles that touch at C .
 A , B and C are points on the small circle, centre X .
 C , D and E are points on the large circle, centre Y .
 $AXCYE$ and BCD are straight lines and $\angle YDE = x^\circ$.

- (a) Prove that triangle BCX is similar to triangle DCY .
 Give a reason for each statement you make.

[3]

(b) Find, in terms of x ,

(i) $\hat{DCY}$,

Answer $\hat{DCY} = \dots\dots\dots$ [1]

(ii) $\hat{BXA}$.

Answer $\hat{BXA} = \dots\dots\dots$ [1]

(c) Given that $BC = 3.5$ cm, $CX = 3.2$ cm and $CD = 5.6$ cm, find the length of AE .

Answer $AE = \dots\dots\dots$ cm [3]

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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

October/November 2019

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **19** printed pages and **1** blank page.

1 Neema travels on a business trip.

- (a) The total cost of her flight is \$406 including tax.
The cost of the flight excluding tax is \$350.

Calculate the tax as a percentage of \$350.

..... % [2]

- (b) Neema takes a suitcase with mass 15.5 kg, correct to the nearest 0.5 kg.
She also takes 6 packets each with mass 1.2 kg, correct to the nearest 0.1 kg.
She has a luggage limit of exactly 23 kg for the flight.

Can Neema be certain that the mass of her luggage is below the limit?
Show how you decide.

.....
..... [2]

- (c) Neema changes \$245 to euros (€) for the trip.
The exchange rate is $\$1 = €0.73$.

On the trip she spends €124.

When she returns, she changes the remaining euros back to dollars at a rate of $\$1 = €0.76$.

Calculate the amount of money she receives.
Give your answer correct to the nearest dollar.

\$ [3]

- (d) On her next trip, Neema hires a car.
 She drives a total of 657 km in the car.
 The car uses fuel at a rate of 4.3 litres per 100 km driven.
 Neema pays \$1.29 per litre of fuel.

Calculate the amount she spends on fuel during the trip.

\$ [3]

- (e) Neema stays in a hotel for 7 nights.
 This is her hotel bill.

Item	Cost
7 nights at \$..... per night	\$805
4 dinners at \$..... each	\$.....
Total before tax	\$.....
Total including tax at 6.5%	\$996.84

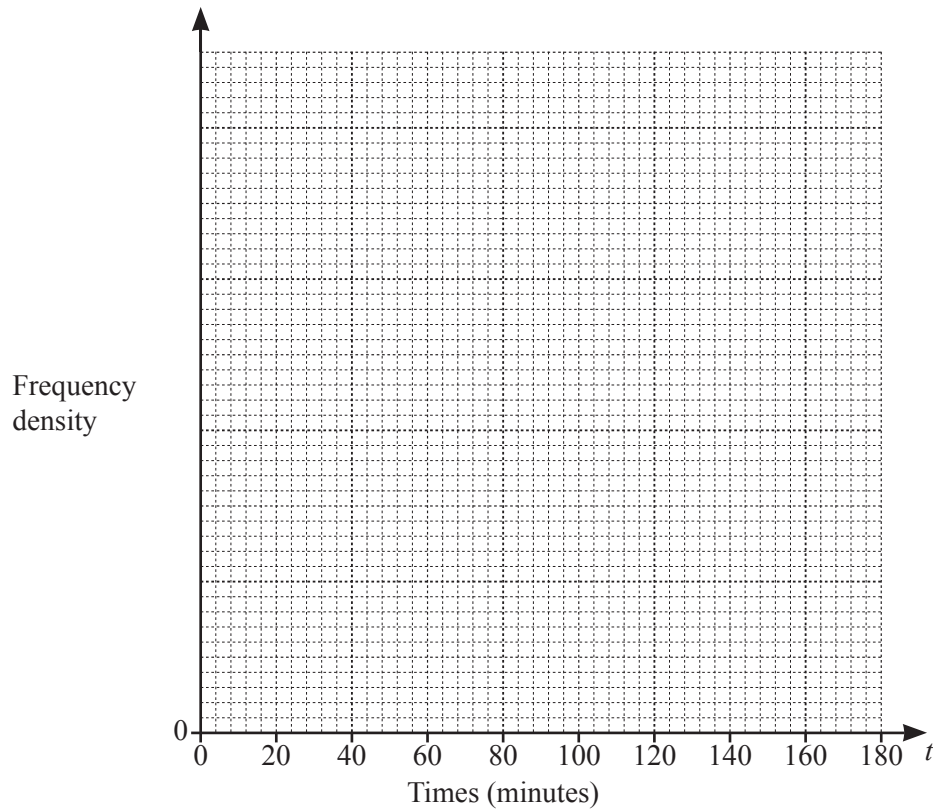
Complete the missing values in the hotel bill.

[4]

- 2 (a) One afternoon, there were 200 visitors to a library.
The table summarises the time, in minutes, each visitor spent in the library.

Time (t minutes)	$0 < t \leq 20$	$20 < t \leq 40$	$40 < t \leq 60$	$60 < t \leq 90$	$90 < t \leq 180$
Frequency	26	76	56	24	18

- (i) On the grid, draw a histogram to represent this data.



[3]

- (ii) Work out the percentage of these visitors who spent more than 40 minutes in the library.

..... % [2]

- (b) Mario recorded the number of books borrowed by each of the 200 visitors to the library. His results are shown in the table.

Number of books	0	1	2	3	4	5	6
Frequency	17	47	42	28	32	21	13

- (i) Find the median.

..... [1]

- (ii) Calculate the mean.

..... [2]

- (iii) One of the visitors is selected at random.

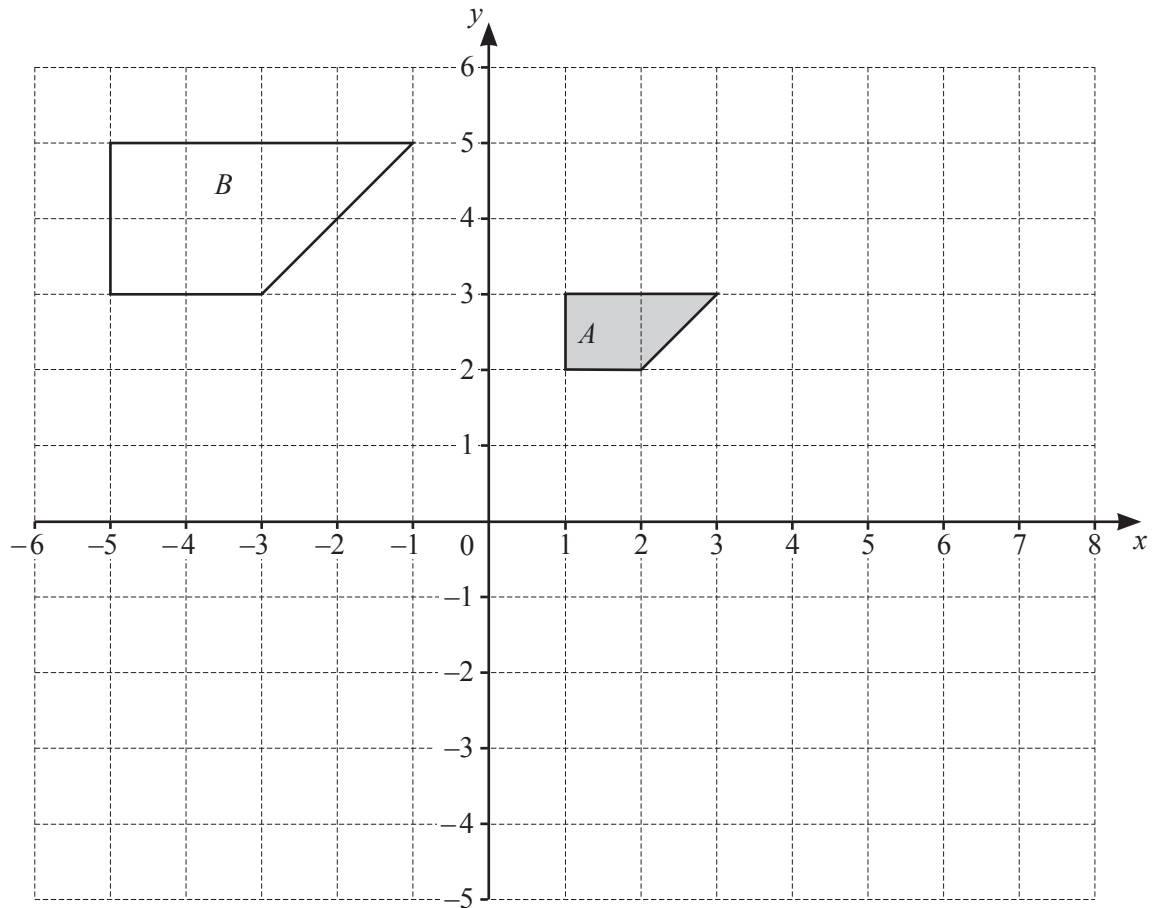
Find the probability that this visitor borrowed more than 4 books.

..... [1]

- (iv) Two of the visitors are selected at random.

Find the probability that only one of them borrowed 6 books.
Give your answer as a decimal correct to 4 significant figures.

..... [3]



Shape A and shape B are drawn on the grid.

- (a) Describe fully the enlargement that maps shape A onto shape B .

.....
 [2]

- (b) Shape A is mapped onto shape C by a rotation of 90° clockwise, centre $(1, 0)$.

Draw and label shape C on the grid.

[2]

- (c) Transformation P is represented by the matrix $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$.

P maps shape *A* onto shape *D*.

- (i) Draw and label shape *D* on the grid. [2]

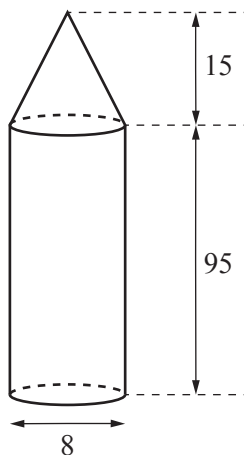
- (ii) Describe fully the **single** transformation P.

.....

..... [2]

4 [Volume of cone = $\frac{1}{3}\pi r^2 h$]

[Curved surface area of a cone = $\pi r l$]



The diagram shows a gate post.

It is made in the shape of a cylinder with a cone on top.

The cylinder and the cone each have diameter 8 cm.

The height of the cylinder is 95 cm and the height of the cone is 15 cm.

(a) Calculate the volume of the gate post.

..... cm³ [3]

(b) Show that the total curved surface area of the gate post is 2580 cm², correct to 3 significant figures.

[5]

- (c) A geometrically similar gate post has a **total** height of 150 cm.

Calculate the total curved surface area of this gate post.

..... cm² [2]

5 (a) (i) $x^2 + 7x - 13 = (x + a)^2 + b$

Find the value of a and the value of b .

$$a = \dots\dots\dots$$

$$b = \dots\dots\dots [2]$$

- (ii) Hence solve the equation $x^2 + 7x - 13 = 0$.
Show your working and give your answers correct to 3 significant figures.

$$x = \dots\dots\dots \text{ or } x = \dots\dots\dots [2]$$

(b) Simplify $\frac{4x^2 - 9}{2x^2 - 11x + 12}$.

$$\dots\dots\dots [3]$$

(c) Solve $\frac{2x}{x+4} + \frac{6}{x-1} = 2$.

$x = \dots\dots\dots$ [4]

- 6 These are the first four patterns in a sequence made using counters.

Pattern 1



Pattern 2



Pattern 3



Pattern 4



- (a) Complete the table for the patterns in this sequence.

Pattern number	1	2	3	4	5
Number of counters	3	8	15		

[1]

- (b) Find an expression, in terms of n , for the number of counters in Pattern n .

..... [2]

- (c) Ken has a bag containing 1358 counters.
He makes the largest possible pattern in the sequence, Pattern p , using these counters.

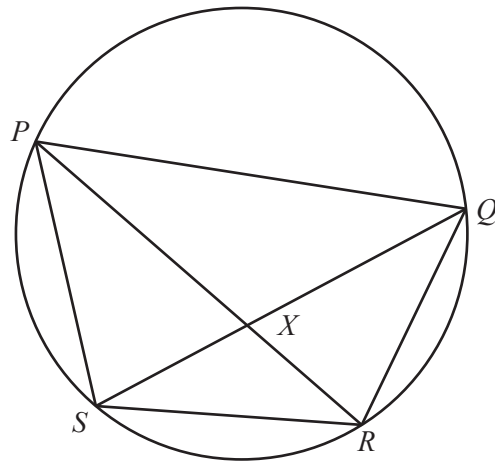
- (i) Find the value of p .

$p =$ [3]

- (ii) He uses all of the remaining counters to make another pattern in the sequence, Pattern q .

Find the value of q .

$q =$ [2]



NOT TO
SCALE

P , Q , R and S are points on a circle.
 PXR and QXS are straight lines.

- (a) Show that triangle PQX is similar to triangle SRX .
Give a reason for each statement you make.

.....

 [3]

- (b) $PX = 8.1$ cm, $QX = 6.3$ cm and $SX = 4.5$ cm.

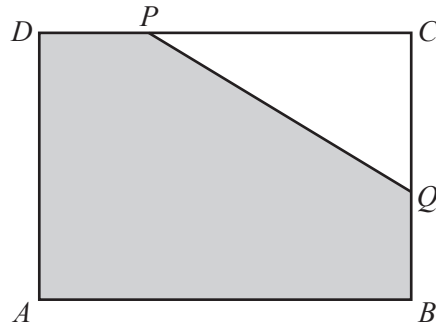
- (i) Calculate RX .

..... cm [2]

- (ii) Find the ratio area of triangle PQX : area of triangle PSX .
Give your answer in its simplest form.

..... : [2]

8

NOT TO
SCALE

Rectangle $ABCD$ has area 80 cm^2 .

Triangle PCQ is removed from one corner of the rectangle.

$BQ = DP = 4\text{ cm}$.

$AB = x\text{ cm}$.

- (a) Write down an expression, in terms of x , for CP .

..... [1]

- (b) Explain why $CQ = \left(\frac{80}{x} - 4\right)\text{ cm}$.

.....

 [1]

- (c) Show that the shaded area, $y\text{ cm}^2$, is given by

$$y = 32 + 2x + \frac{160}{x}.$$

[3]

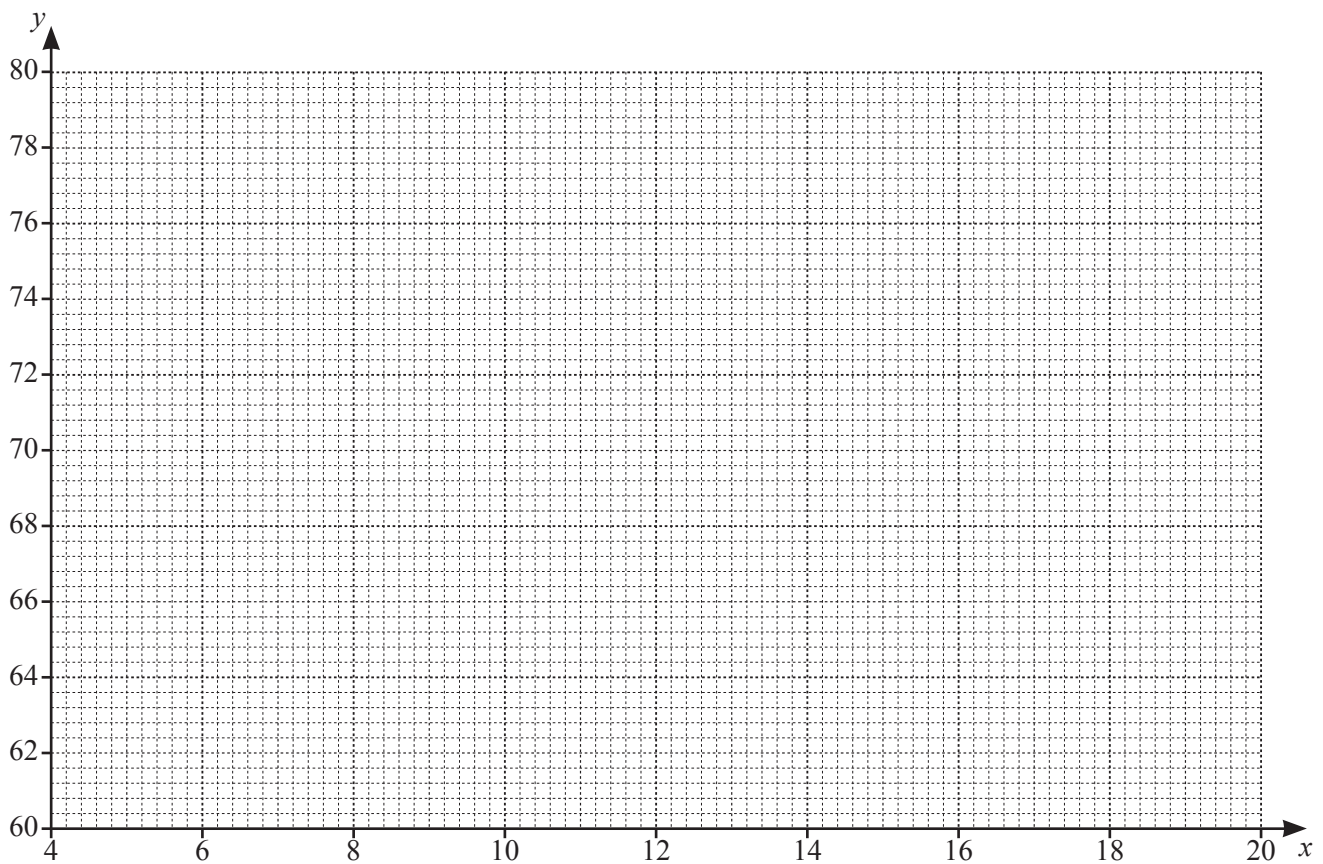
- (d) Complete the table for $y = 32 + 2x + \frac{160}{x}$.

Values are given to 1 decimal place where appropriate.

x	4	6	8	10	12	14	16	18	20
y	80	70.7	68	68	69.3	71.4		76.9	80

[1]

- (e) On the grid, draw the graph of $y = 32 + 2x + \frac{160}{x}$ for $4 \leq x \leq 20$.

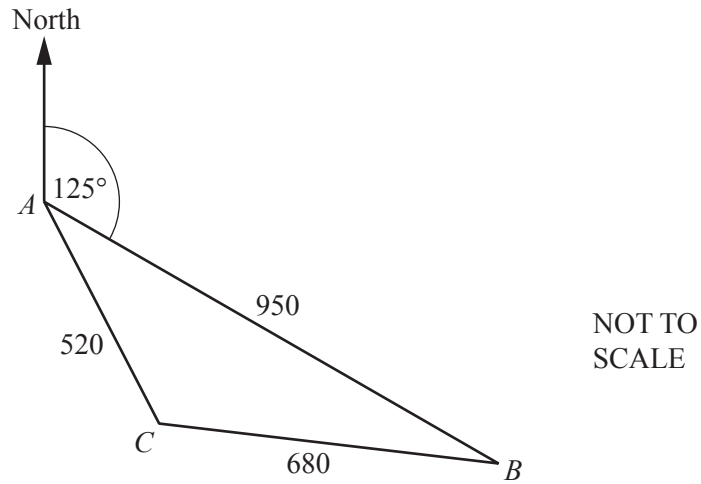


[3]

- (f) Use your graph to find the minimum possible shaded area.

..... cm^2 [1]

9



The diagram shows the positions of three farms A , B and C on horizontal ground.
 Farm B is on a bearing of 125° from farm A .
 $AB = 950\text{ m}$, $BC = 680\text{ m}$ and $AC = 520\text{ m}$.

- (a) Show that $\hat{BAC} = 44.0^\circ$, correct to 1 decimal place.

[3]

- (b) Calculate the bearing of A from C .

..... [1]

- (c) Farm A and farm B are joined by a straight track AB .
Amira walks along the track from A at a constant speed of 4.6 km/h .

Calculate the time it takes for Amira to walk from A to the point that is closest to farm C .
Give your answer in minutes and seconds, correct to the nearest second.

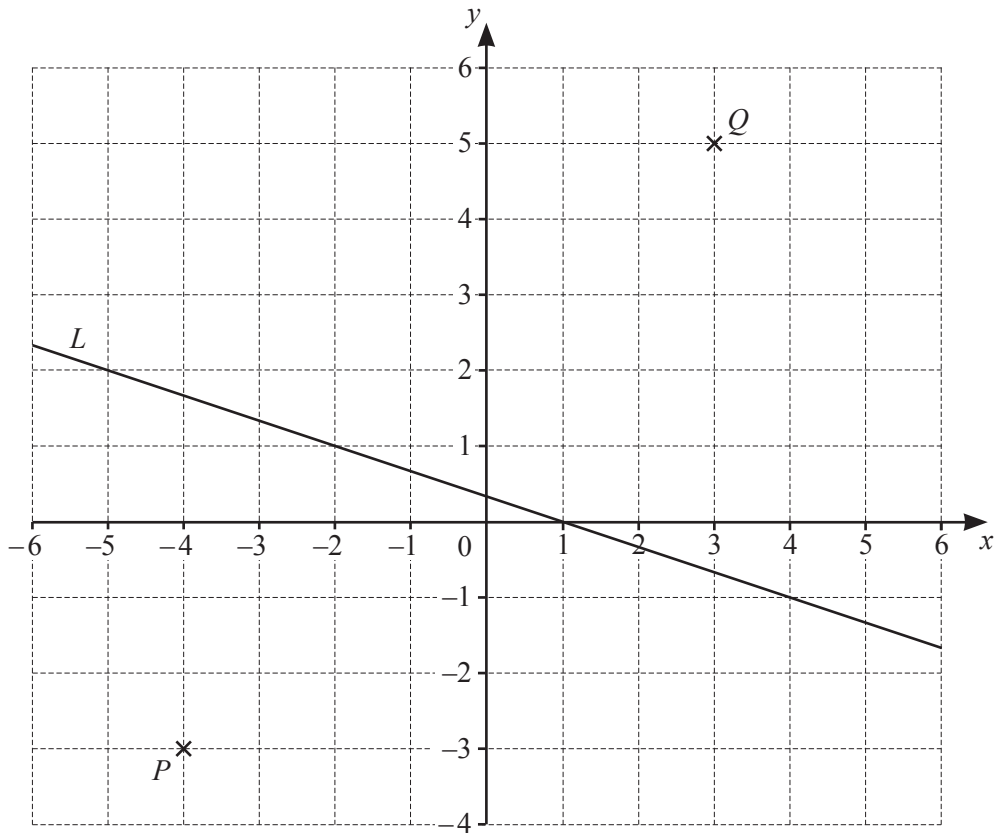
..... minutes seconds [4]

- (d) A helicopter hovers vertically above farm B .
The angle of elevation of the helicopter from farm A is 10.7° .

Calculate the angle of elevation of the helicopter from farm C .

..... [4]

10



Points P and Q and the line L are shown on the grid.

(a) Calculate the length of PQ .

..... cm [2]

(b) Show that the equation of line L is $3y + x = 1$.

[3]

- (c) Line M is perpendicular to line L and passes through point P .

Find the equation of line M .

Give your answer in the form $y = mx + c$.

$y = \dots\dots\dots$ [3]

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4024/22

October/November 2019

2 hours 30 minutes

Additional Materials: Geometrical instruments
Electronic calculator

READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The total of the marks for this paper is 100.

This document consists of **19** printed pages and **1** blank page.

1 Tanya owns a small business.

(a) Tanya has 4 employees.

Every week, the employees each work for $7\frac{3}{4}$ hours each day for 5 days.
Each employee is paid \$15.20 per hour.

Calculate the total amount Tanya pays her 4 employees in one week.

\$ [2]

(b) The business made a profit of \$25 700 in 2017 compared with \$22 102 in 2018.

Calculate the percentage decrease in profit from 2017 to 2018.

..... % [2]

(c) Tanya must add 8% sales tax to the initial cost of a job.

She then adds 15% to the cost, including sales tax, to find the amount to charge a client.
Tanya charges one client a total of \$465.75 for a job.

Calculate the initial cost of this job.

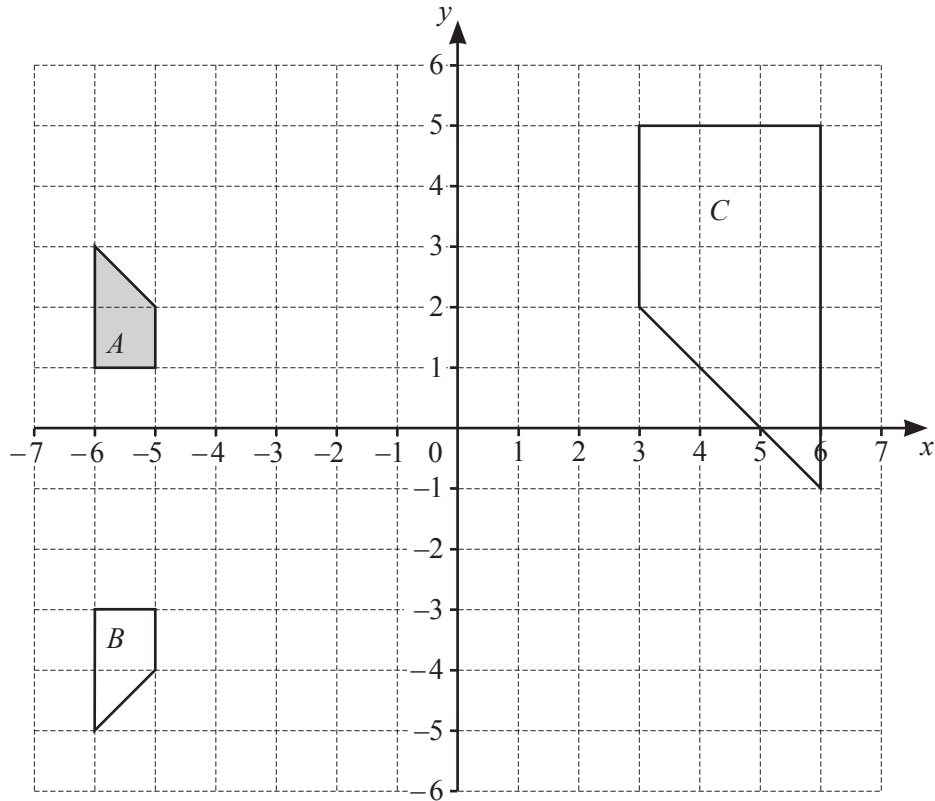
\$ [3]

(d) Tanya invests \$8500 in an account paying 3.1% per year compound interest.

At the end of 5 years she takes \$9300 from the account to buy new equipment for the business.

Calculate how much money is left in the account after buying the new equipment.

\$ [3]



Shapes A , B and C are drawn on the grid.

- (a) Shape A is mapped onto shape B by a reflection.

Write down the equation of the line of reflection.

..... [1]

- (b) Describe fully the **single** transformation that maps shape A onto shape C .

.....
 [3]

- (c) Transformation T is represented by the matrix $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$.

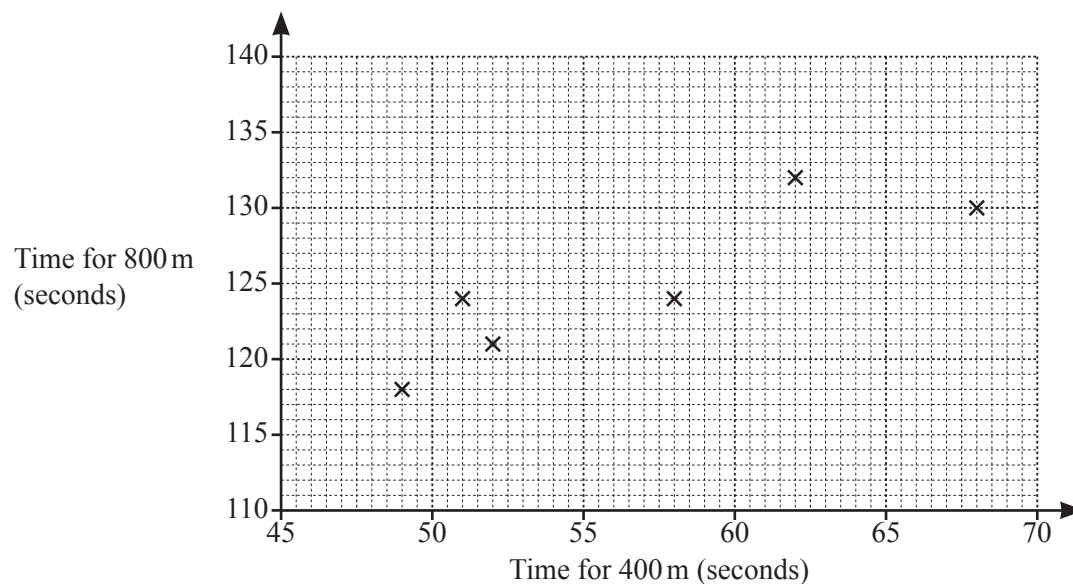
T maps shape A onto shape D .

Draw and label shape D . [2]

- 3 (a) The table shows the times, in seconds, taken for each of 12 members of an athletics club to run 400 metres and 800 metres.

Time for 400 m (seconds)	49	62	58	52	51	68	56	63	50	61	53	55
Time for 800 m (seconds)	118	132	124	121	124	130	129	138	126	131	119	127

- (i) On the grid, complete the scatter diagram.
The first six points have been plotted for you.



[2]

- (ii) Runners who took less than 55 seconds to run 400 metres **and** less than 125 seconds to run 800 metres are selected to enter an athletics competition.

How many of these runners are selected for the competition?

..... [1]

- (iii) What type of correlation does the scatter diagram show?

..... [1]

- (iv) Draw a line of best fit on the scatter diagram.

[1]

- (v) Another runner took 65 seconds to run 400 metres.

Use your line of best fit to estimate how long they would take to run 800 metres.

..... s [1]

- (b) 50 members of the athletics club attempted the high jump.
The table summarises the heights, in centimetres, of their jumps.

Height (h cm)	$140 < h \leq 145$	$145 < h \leq 150$	$150 < h \leq 155$	$155 < h \leq 160$	$160 < h \leq 165$
Frequency	p	10	15	13	q

The athletics coach uses the mid-interval values to calculate an estimate of the mean height jumped by the 50 athletes.

His estimate of the mean is 153.6 cm.

- (i) Explain why $p + q = 12$.

.....

..... [1]

- (ii) Show that $142.5p + 162.5q = 1870$.

[2]

- (iii) Find the value of p and the value of q .
Show your working.

$p =$

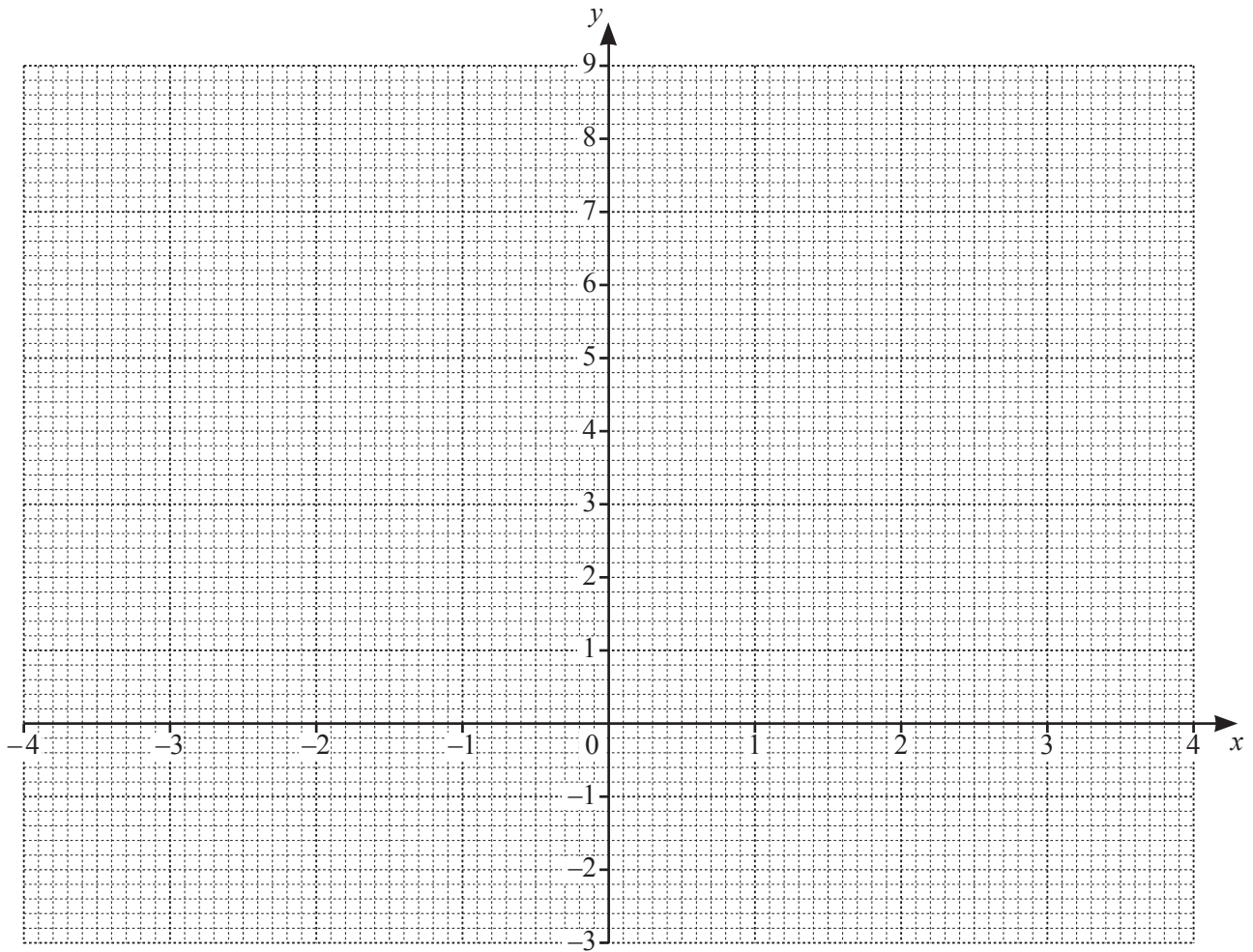
$q =$ [3]

- 4 (a) Complete the table for $y = 3 + 2x - \frac{x^3}{5}$.

x	-4	-3	-2	-1	0	1	2	3	4
y	7.8	2.4	0.6	1.2	3	4.8	5.4	3.6	

[1]

- (b) Draw the graph of $y = 3 + 2x - \frac{x^3}{5}$ for $-4 \leq x \leq 4$.



[3]

- (c) By drawing a tangent, estimate the gradient of the graph of $y = 3 + 2x - \frac{x^3}{5}$ at $(1, 4.8)$.

..... [2]

- (d) (i) On the grid, draw the line $2y + x = 8$.

[2]

- (ii) Write down the x -coordinates of the points where the line intersects the graph of $y = 3 + 2x - \frac{x^3}{5}$.

..... [2]

- (iii) These x -coordinates are the solutions of the equation $2x^3 + Ax + B = 0$.

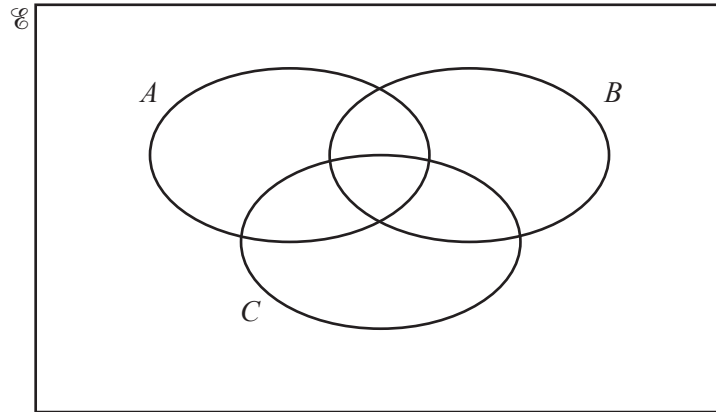
Find the value of A and the value of B .

$A =$

$B =$ [3]

- 5 (a) $\mathcal{E} = \{x : x \text{ is an integer } 1 \leq x \leq 16\}$
 $A = \{x : x \text{ is an even number}\}$
 $B = \{x : x \text{ is a square number}\}$
 $C = \{x : x \text{ is a factor of } 100\}$

(i) Complete the Venn diagram.



[3]

(ii) Find $n(A' \cup B)$.

..... [1]

(iii) $p \in A \cap C$

Write down all the possible values of p .

..... [1]

(b) Ateeq has a set of 16 cards numbered from 1 to 16.

(i) He takes a card from the set at random.

Find the probability that the card shows an odd square number.

..... [1]

(ii) Ateeq takes two cards at random from the set of 16 cards.

Find the probability that both cards show even numbers that are factors of 100.

..... [2]

- 6 (a) Rearrange the formula $v = \frac{3}{p+5}$ to make p the subject.

$$p = \dots\dots\dots [2]$$

- (b) Express as a single fraction in its simplest form $\frac{x}{2x-5} + \frac{3}{x-6}$.

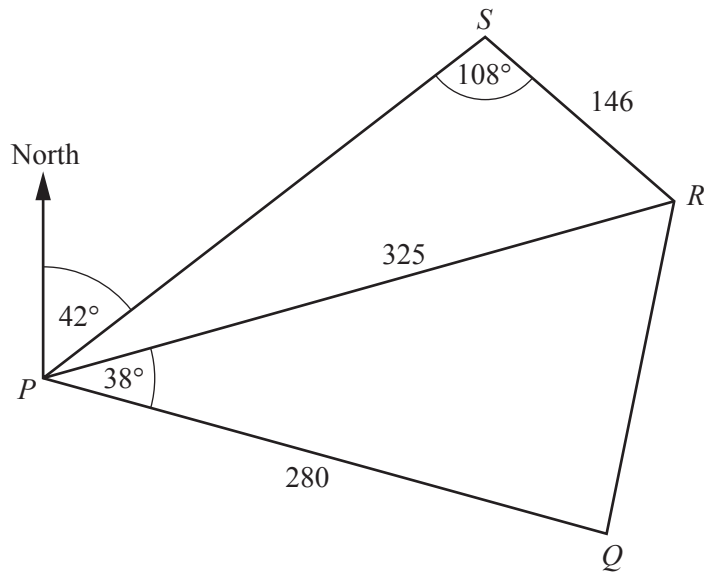
$$\dots\dots\dots [3]$$

- (c) Solve $\frac{4x+5}{1-3x} = 2$.

$$x = \dots\dots\dots [3]$$

- (d) Solve $5(x+3) = 2x(2x-1)$.
Show your working.

$x = \dots\dots\dots$ or $x = \dots\dots\dots$ [4]



NOT TO
SCALE

A field is in the shape of a quadrilateral $PQRS$.

A path crosses the field from P to R .

$PQ = 280$ m, $RS = 146$ m and $PR = 325$ m.

S is on a bearing of 042° from P , $\angle PSR = 108^\circ$ and $\angle RPQ = 38^\circ$.

(a) Calculate the bearing of R from P .

..... [4]

(b) (i) Show that $QR = 202$ m, correct to the nearest metre.

[3]

- (ii) Mia walks at a constant speed of 5.5 km/h.

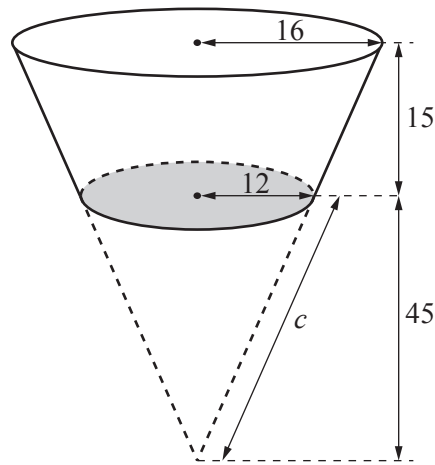
Calculate the time it takes her to walk from Q to R .

Give your answer in minutes and seconds, correct to the nearest second.

..... minutes seconds [3]

8 [Volume of cone = $\frac{1}{3}\pi r^2 h$]

[Curved surface area of a cone = $\pi r l$]



The diagram shows a bowl with a circular base.

The curved surface of the bowl is formed by removing a cone with radius 12 cm and height 45 cm from a larger cone as shown in the diagram.

The radius of the top of the bowl is 16 cm and its height is 15 cm.

- (a) Calculate the volume of the bowl.

..... cm³ [3]

- (b) The slant height of the cone that has been removed is c cm.

Show that $c = 46.6$, correct to 3 significant figures.

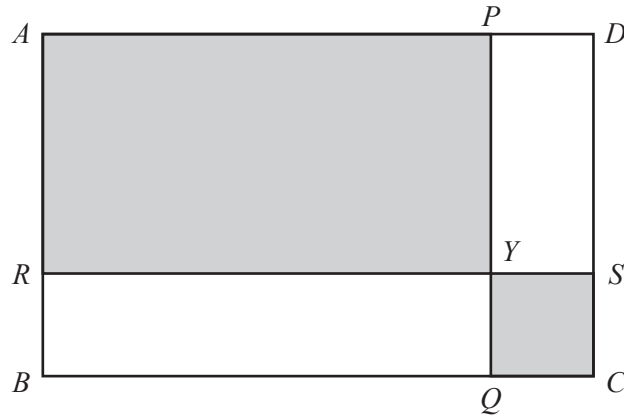
[2]

- (c) The bowl is completely filled with water.

Calculate the total surface area of the bowl that is in contact with the water.

..... cm^2 [4]

9

NOT TO
SCALE

$ABCD$ is a rectangle with $AB = 10$ cm and $AD = 12$ cm.

PQ is parallel to AB and RS is parallel to AD .

Y is the point of intersection of PQ and RS .

$BR = DP = x$ cm.

A smaller rectangle and a square are shaded.

(a) Write down an expression, in terms of x , for

(i) AR ,

..... cm [1]

(ii) AP .

..... cm [1]

(b) $\frac{\text{Area of shaded rectangle } ARYP}{\text{Area of rectangle } ABCD} = \frac{3}{4}$

Show that $x^2 - 22x + 30 = 0$.

[3]

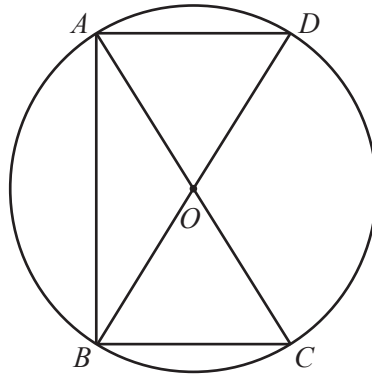
- (c) Solve the equation $x^2 - 22x + 30 = 0$.
Show your working and give your answers correct to 2 decimal places.

$x = \dots\dots\dots$ or $x = \dots\dots\dots$ [3]

- (d) Find the total **unshaded** area in rectangle $ABCD$.

$\dots\dots\dots \text{ cm}^2$ [2]

10 (a)

NOT TO
SCALE

AC and BD are diameters of the circle, centre O .

Show that triangle ABC is congruent to triangle BAD .
Give a reason for each statement you make.

.....

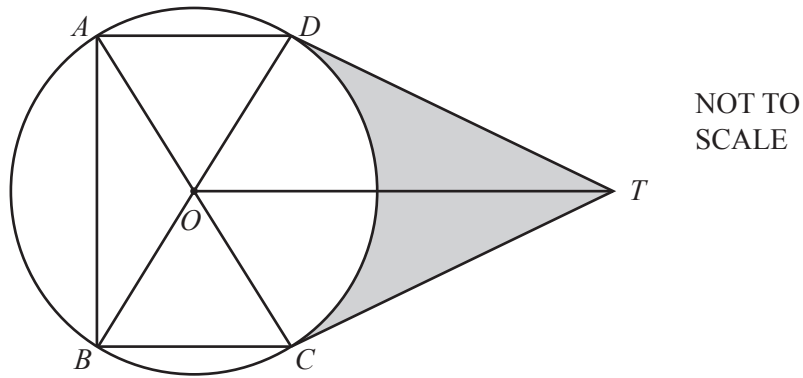
.....

.....

.....

[3]

(b)



Two tangents, TC and TD , are drawn to the circle in **part (a)**.
The diameter of the circle is 8 cm and $\hat{ABD} = 28^\circ$.

(i) Find $\hat{COD}$.

$\hat{COD} = \dots\dots\dots$ [2]

(ii) Calculate the area shown shaded in the diagram.

$\dots\dots\dots \text{ cm}^2$ [5]

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